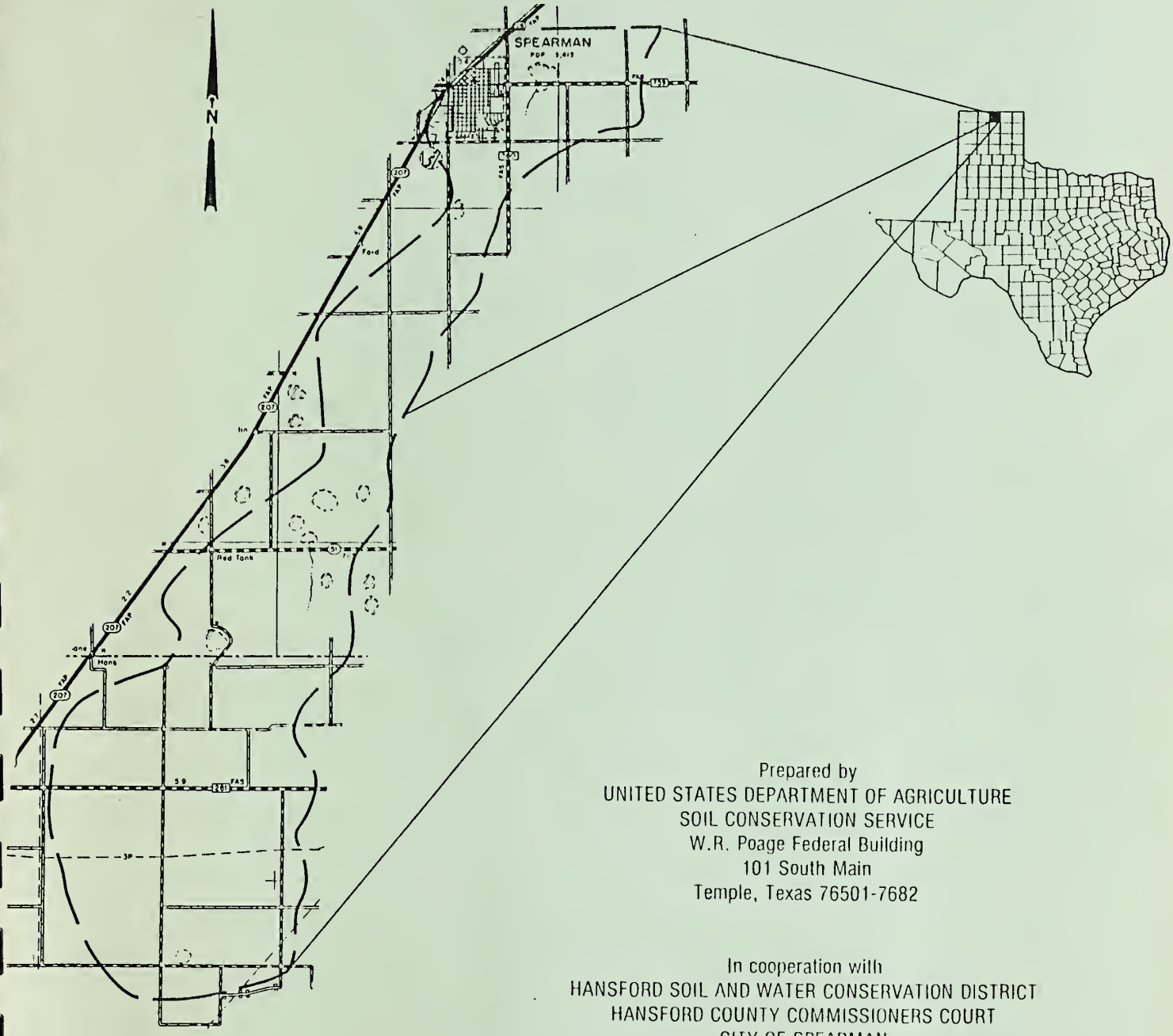
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS



Prepared by
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
W.R. Poage Federal Building
101 South Main
Temple, Texas 76501-7682

In cooperation with
HANSFORD SOIL AND WATER CONSERVATION DISTRICT
HANSFORD COUNTY COMMISSIONERS COURT
CITY OF SPEARMAN
AND THE
TEXAS WATER COMMISSION
APRIL 1986

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FLOOD PLAIN MANAGEMENT STUDY

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HANSFORD COUNTY, TEXAS

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INTRODUCTION

This flood plain management study report identifies areas of flood plain subject to flooding by an unnamed drainageway which carries floodwaters through the city of Spearman and vicinity, Hansford County, Texas. The unnamed drainageway is designated Spearman Draw in this study.

The assistance and cooperation given by the agencies, organizations and individuals during the city of Spearman Flood Plain Management Study is greatly appreciated. These include:

-- Hansford Soil and Water Conservation District
-- City of Spearman
-- Hansford County Commissioners Court

Special appreciation is extended to the individuals who contributed information for the study. Appreciation is also extended to the landowners who permitted access to their property for surveys, photographs, and reconnaissance.

The city of Spearman is located in the High Plains of Texas between the well defined drainageway on the west called Horse Creek and a poorly defined unnamed drainageway on the east. Horse Creek has a well defined channel and valley and is beyond the west city limits of Spearman. The poorly defined unnamed drainageway on the east, designated Spearman Draw in this study, frequently floods areas within and adjacent to the city of Spearman. This is the area studied.

The city of Spearman is presently in the emergency flood insurance program; however, no detailed flood insurance study has been made or scheduled.

This cooperative study was requested by the city of Spearman, the Hansford Soil and Water Conservation District, Hansford County Commissioners Court, and the Texas Water Commission in order to obtain a factual basis for reducing future flood damages and flood hazards through carefully considered and well planned local regulations and use of the flood plain.

The study was conducted according to the December 1983 Plan of Work developed and endorsed by the above named requesting entities and the Soil Conservation Service (SCS).

The SCS conducts cooperative flood plain management studies in Texas through the November 1973 Joint Coordination Agreement (Revised 10/30/78) between the SCS and the Texas Department of Water Resources 1/. SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management," and Section 6 of Public Law 83-566. The principles contained in Executive Order 11988, Flood Plain Management, are addressed in this part.

1/ Changed to Texas Water Commission in 1985 by the 69th Texas Legislature.

Topographic data for this study were obtained from field surveys and Geological Survey topographic maps. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Peak discharge values were determined by flood routing various storm frequencies with a 24-hour rainfall duration using SCS Technical Release No. 20, A Computer Program for Project Formulation, Hydrology. Water surface profiles were developed by the Modified Slope Area Method using SCS Technical Release No. 61, WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates.

DESCRIPTION OF STUDY AREA

The study area consists of an unnamed poorly defined drainageway designated Spearman Draw in this study. The study area is in Geological Survey Hydrologic Unit Number 11100104. The watershed is in the Water Resources Council Arkansas-Red-White Region, Subregion 10, and Canadian River Basin.

Spearman Draw heads approximately 16 miles southwest of Spearman in Hutchinson County. It consists of a series of depressions and playas with occasional reaches where the channel can be defined. In periods of low rainfall, the runoff that does occur is contained in the many playas. During wet periods or high runoff producing storms, the playas fill-up and overflow. The resulting flows move down the drainageway through the city of Spearman and adjacent areas. The path of travel is approximately 20.9 stream miles. The study limit terminates approximately 1.5 miles northeast of the city of Spearman corporate limits. The total drainage area of the study area is 45.4 square miles or 29,040 acres.

The stream length studied in detail is 5.1 miles involving a flood plain area of approximately 4,000 acres.

The city of Spearman is the only community located within the study area. The 1980 census gives the population of Spearman as 3,413.

The Index and Study Area Map, Appendix, page 6, shows the stream reach and area that was studied.

The study area watershed has a semiarid climate characterized by low humidity and wide ranges in daily and annual temperature. Summer days are warm, but wind and low humidity keep them from being uncomfortable. Nights are cool and pleasant. The winters are mild enough for outdoor work. There are a few cold spells, lasting several days, during which the night temperature drops to near zero. These cold spells come quickly. Cold fronts from the northern Rocky Mountains and Northern Plains States sweep across the level prairie of this county at speeds up to 40 miles per hour. The temperature may drop 50 to 60 degrees within a 12-hour period. The January average minimum temperature is 20 degrees Fahrenheit. The July average maximum temperature is 94 degrees Fahrenheit.

The average annual precipitation is about 22 inches, but the range is wide, or from 8 inches, in 1930, to 36 inches in 1950. On the average, 60 percent of the total precipitation falls in the period May 1 to September 30. This average, however, does not indicate the frequent droughts, nor the fact that much of the summer rainfall comes as thunderstorms.

The annual snowfall averages about 17 inches, but in some seasons it has been less than an inch, and in others it has been more than 40 inches. The snow tends to blow into drifts and soon melts when the temperature rises. It is seldom on the ground for more than a few days.

Winds are strong because there are no sheltering mountain ranges or timbered areas. March and April are the windiest months. The average wind velocity is about 13.4 miles per hour in March, and 14.1 miles per hour in April. The prevailing winds come from the south. The strongest winds are from the north, and they normally come in winter. Winds of more than 65 miles per hour have been recorded.

The average growing season at Spearman is about 184 days.

The study area is in the High Plains Land Resource Area.

NATURAL VALUES

The study area is located in the High Plains Land Resource Area. The original vegetation on this relative flat plateau was classified as a mixed prairie. Short grasses occurred on the loamy or clayey soils with mid to tall grasses on the more sandy areas.

Presently, the study area is being intensively cropped. Approximately 94 percent of the study area is cropland. Major crops being grown are grain sorghum and wheat. Other crops include corn, soybeans and alfalfa.

Other land uses in the study area are urban area and rangeland.

The urban area which includes the city of Spearman covers 2 percent of the study area.

Rangeland or native grassland in the study area is normally restricted to playa lakes and adjacent areas which are too wet to farm. It covers 4 percent of the watershed. Vegetation in these areas is primarily herbaceous. Principal species are sedges, blue grama, buffalograss, silver bluestem, vine mesquite and annual forbs.

The land use in the 500-year flood plain is 86 percent cropland, 11 percent rangeland including playas not being farmed and 3 percent urban area. The major and most important natural value of the flood plain is its ability to transport floodwater.

PRIME FARMLAND SOILS

A large extent of the study area is prime farmland soils. Approximately 93 percent of the study area is classified as prime farmland soils and 83 percent of the flood plain is prime farmland soils.

WETLANDS

The wetlands in the study area are playa lakes. They are classified as Type 1 wetlands by the U.S. Fish and Wildlife Service in their publication, "Circular 39, Wetlands of the United States." Approximately 1,528 acres of Type 1

wetlands occur in the study areas. Of this, 162 acres occur in the 500-year flood plain.

FISH AND WILDLIFE HABITAT

Fishery resources in the study area are restricted to ponds for livestock water and playa lakes which have permanent water. Principal fish species stocked in these water impoundments are largemouth bass, channel catfish and sunfish.

Wildlife resources are limited in the study area. The lack of habitat diversity limits the variety of wildlife to those species which inhabit cropland and the playas. Major game species are ring-necked pheasant, dove and waterfowl. Other species include hawks, jackrabbit, cottontail, and numerous species of rodents, and passerine birds.

THREATENED AND ENDANGERED SPECIES

No listed threatened or endangered species or critical habitat occur in the study area.

FLOOD PROBLEMS

Although a number of city residences, businesses and public buildings have suffered flood damage from previous floods, it was found during this study that the source of these floodwaters in most instances is local surface runoff water, not overbank floodwater from Spearman Draw. This type of flooding can be alleviated by providing adequate storm drainage for the city streets.

Overbank floodwaters from Spearman Draw do affect the Spearman High School athletic facilities and an undeveloped area located in the southeast portion of the city of Spearman corporate limits.

Two rural residences including the farm headquarters buildings are affected by floodwaters from Spearman Draw. Also, approximately 1,400 acres of cropland of which approximately 80 percent is irrigated are affected by floodwaters from Spearman Draw.

Potential flood heights for the 100-year and 500-year floods photographed at two locations to illustrate the flood problems are shown on page 9, Figures 1 and 2.

Following is a tabulation of the acreages of rural and urban areas subject to inundation by the 100-year and 500-year floods.

Table 1
FLOODED AREAS
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY

	Rural (Acres)	Urban (Acres)	Total (Acres)
Within the 100-year frequency flood plain	1,470	36	1,506
Within the 500-year frequency flood plain	1,590	41	1,631

Upstream flood plain and watershed land use changes anticipated by local officials within the next 10 to 15 years are not expected to significantly affect future flood elevations on the flood plains of the study area.

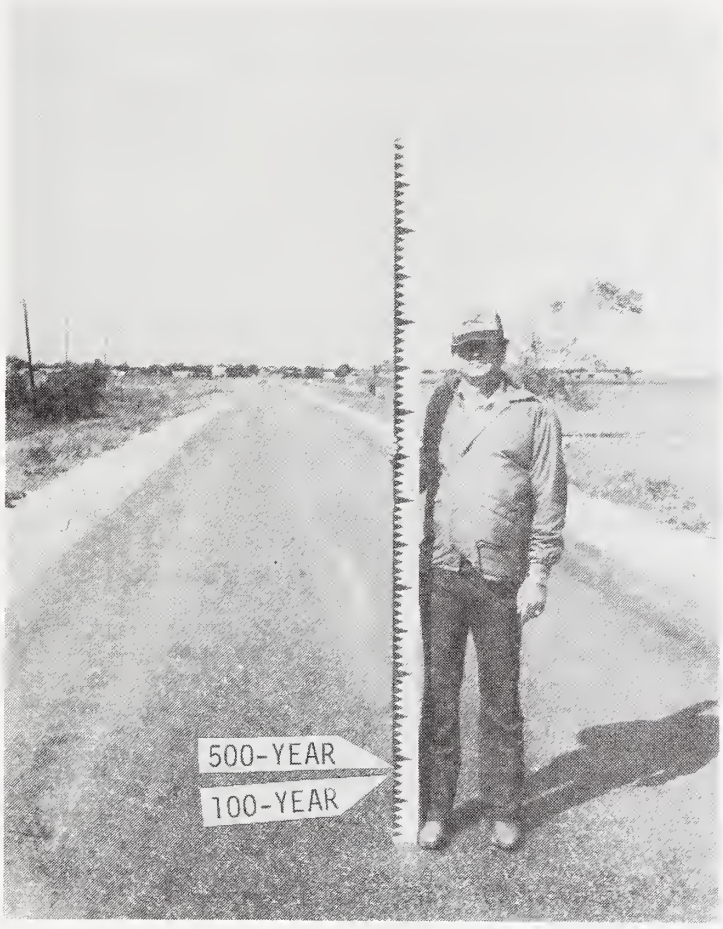
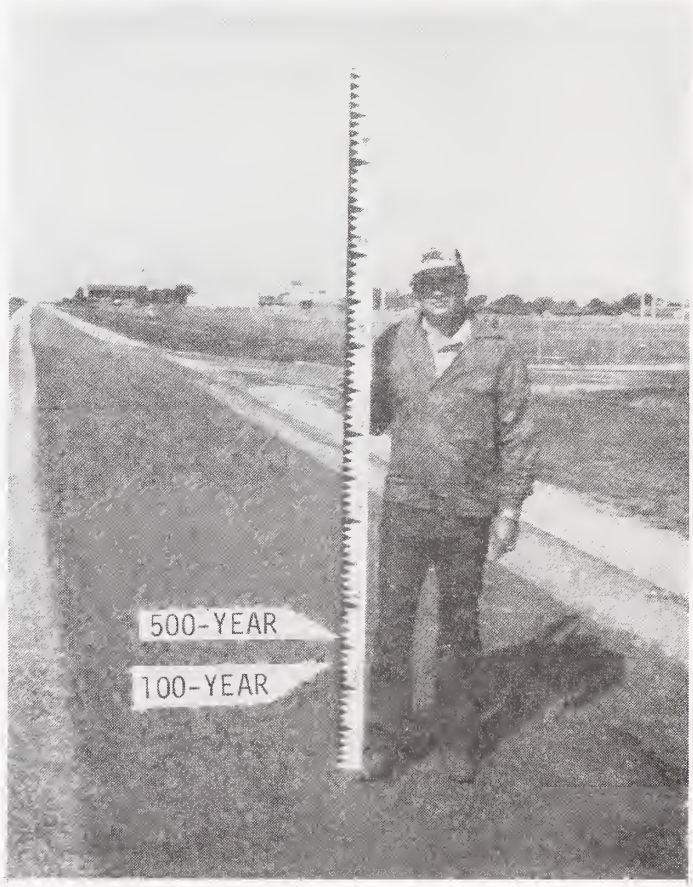


Figure 1 -- Potential flood heights at cross section 6, station 6100, at low point in road approximately 140 feet east of culvert where State Highway 759 crosses Spearman Draw.

Figure 2 -- Potential flood heights at cross section 11, station 4300, at low point in road near intersection of Cotter Drive and county road south of Spearman High School.



EXISTING FLOOD PLAIN MANAGEMENT

The 61st Texas Legislature in 1969 enacted the Texas Flood Control and Insurance Act, Article 8280-13 VACS, and Article 1581e-1 VACS. Article 8280-13 named the Texas Water Development Board and the State Board of Insurance as the responsible state-level agencies in respect to the National Flood Insurance Program. In 1985, the 69th Texas Legislature created the Texas Water Development Board and the Texas Water Commission from the Texas Department of Water Resources. Article 8280-13 was codified in Texas Water Code (Subchapter I, Section 16.311), and responsibility for the flood insurance program in Texas was assigned to the Texas Water Commission and the State Board of Insurance. Subchapter I, Section 16.315 of the Code authorizes all political subdivisions, including cities, counties, and many types of special purpose districts and authorities, to take all necessary and reasonable actions to comply with the requirements and criteria of the National Flood Insurance Program.

At the present time, state-level statutory controls on use and management of flood hazard areas are fairly limited. Subchapter G, Section 16.236 of the Texas Water Code requires the Texas Water Commission or the local political entity to approve plans for any levee or other such improvement which may change floodflows of any stream in Texas that is subject to floods. Also, in December 1977, Governor Briscoe issued Executive Order No. 34-A calling for state agencies to implement a flood plain management program for state-owned property and facilities. This state program will utilize state agency rules and regulations calling for evaluation of flood hazards and will conform to

the minimum flood plain management criteria established by the U. S. Department of Housing and Urban Development for the National Flood Insurance Program.

ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT

PRESENT CONDITIONS

Part of the Spearman High School athletic facilities and an undeveloped area located in the southeast portion of the Spearman corporate limits are within the study area flood plain. Residential areas have been developed adjacent to the flood plain, but have not encroached onto the flood plain.

Two rural residences with headquarters buildings are located in the flood plain. The remainder of the study area flood plain is in cropland.

LAND TREATMENT

Effective conservation land treatment is presently being carried out by land users in the watershed. Excess runoff or erosion and sedimentation due to lack of conservation land treatment is not a major cause of flooding.

PRESERVATION AND RESTORATION OF NATURAL VALUES

Since the primary natural value of the study area flood plain is its ability to transport floodwaters, encroachment onto the flood hazard areas of the flood plain with obstacles which interfere with the movement of floodwater should be avoided to preserve its present flowage capacity.

Nonprime farmland soils should be used for construction sites and other non-farm uses in order to preserve prime farmland. Information on prime farmland soils in the study area may be obtained from the Soil Conservation Service Office at Spearman, Texas.

NONSTRUCTURAL MEASURES

Nonstructural measures which will help reduce or minimize flood losses include flood proofing, flood warning systems, relocation, zoning regulations, participation in the national flood insurance program, emergency preparedness, and building or development codes.

Flood proofing can reduce flood damages by a combination of structural provisions and changes or adjustments to properties subject to flooding. Examples of flood proofing are sealing low window and door openings and modifying floor drains to prevent the entrance of flood waters.

Flood warning systems should be coordinated with local disaster plans. The National Weather Service issues warnings of potential flood producing storms. Staff gages set at key locations can be monitored to give advance warnings. A float-activated electronic signal could be connected to the local police or fire station for monitoring.

Relocation involves permanent evacuation of developed areas subject to inundation, acquisition of lands by purchase, removal of improvements and relocation of the population from such areas. Such lands could be used for parks or other purposes that would not suffer large damages and would not interfere with floodflows.

Zoning is a legal method used to implement and enforce the details of the flood plain management program, to preserve property values, and to achieve the most appropriate and beneficial use of available land. Clear, concise, and thorough zoning bylaws with enforcement of the bylaws are essential to make zoning effective.

Flood insurance was established by the National Flood Insurance Act of 1968 (Public Law 90-448, as amended) to make limited amounts of flood insurance, which were previously unavailable from private insurers, available to property owners and occupiers. The Flood Disaster Protection Act of 1973 (Public Law 93-234, as amended) was a major expansion of the National Flood Insurance Program.

Flood insurance is available through local insurance agents and brokers only after a local governing body applies and is declared eligible for the program by the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA). Adoption and enforcement of a local flood prevention ordinance which meets FEMA minimum flood plain management criteria is necessary to qualify and maintain eligibility.

In those communities participating in the FEMA program, owners and occupiers of all buildings and mobile homes in the entire community are eligible to obtain flood insurance coverage. Where flood insurance is available, it is recommended that buildings and mobile homes within or adjacent to the delineated flood hazard areas carry flood insurance on the structure and contents.

Emergency preparedness consists of a plan by local officials to be put into effect in the event of flooding. Procedures are worked out and personnel designated to implement the plan. Methods and procedures to alert and warn the populace of possible flooding are developed. High risk areas, handicapped, elderly or others known to need help during evacuation are located and identified. Plans are made for their evacuation or rescue. Shelters are provided for evacuees.

Building codes are developed to set up minimum standards for controlling the design, construction, and quality of materials used in buildings and structures within a given area to provide safety for life, health, property and public welfare. Building codes can be used to minimize structural and subsequent damages resulting from inundation. Building restriction codes can:

1. Specify adequate anchorage to prevent flotation of buildings from their foundations.

2. Establish basement elevations and minimum first-floor elevations in accordance with potential flood heights.

3. Prevent virtually all damage by elevating the foundation and prohibiting basements in those areas subject to very shallow and frequent flooding.

4. Require building reinforcement to withstand water pressure or high velocity flow and restrict the use of materials which deteriorate rapidly in the presence of water.

5. Prohibit equipment that might be hazarous to life when submerged. This includes chemical storage, boilers, and electrical equipment.

Development policies which are designed to prevent construction of streets and utility systems in flood prone areas tend to slow development of the flood plains.

STRUCTURAL MEASURES

Structural measures such as dams or channels do not appear to be feasible as a means of reducing flood losses due to the lack of favorable site locations.

SELECTED ALTERNATIVE

The alternative for reducing flood losses selected by the city of Spearman for immediate implementation is to contact the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA) and apply for inclusion in the Regular National Flood Insurance Program. The City will adopt and implement the flood plain management ordinances necessary to qualify for and maintain eligibility in the Regular National Flood Insurance Program.

Other alternatives listed in this report will be considered for later implementation.

FLOOD HAZARD MAPS

The index map (Appendix, page 7) shows the stream reach covered by each of the photomaps. The index map also shows the watershed boundaries and stream reaches studied.

The limits of the 100-year and 500-year frequency floods, for present conditions, were delineated on aerial photographs (Appendix, pages 9 to 31) to indicate the extent of area inundated. The 10-year and 50-year frequency floods for present conditions could not be effectively shown on the aerial photographs due to the map scale and topography. The flood lines shown are based on field surveys of roads, bridges, and valley sections used in conjunction with Geological Survey topographic maps having 5-foot contour intervals, and interpretation of aerial photographs. These maps should only be used to determine the approximate boundaries of the flooded areas. Actual dimensions measured on the ground may vary slightly from those measured on the photomaps of this report due to map scale and reproduction limitations. The water surface profile elevations should be used to determine actual on the ground dimensions.

Flood elevations in this report are minimum elevations. Debris may collect at bridges and culverts and clog the channels during major floods and increase the depth of flooding. Analyses were made without showing the effects of potential obstructions. Also extremely rare events such as catastrophic storms were not analyzed.

TECHNICAL APPENDIX

A technical appendix is included in this report. The index map, flood hazard area photomaps and flood profiles are included in the Appendix. The index map shows the study area coverage of individual flood hazard area maps and the watershed boundaries (Appendix, page 7).

The water surface profiles of Spearman Draw show the profiles of the 10-year, 50-year, 100-year, and 500-year frequency floods for present conditions. Included on the profiles are stream elevations of the channel bottom, pertinent bridge and roadway data, and other location data. The stationing of profile is bank full stream channel distance in feet and is based on measured distances from the 1981 flight of aerial photomaps. Flood depths can be estimated at any location on the stream reach from the water surface profiles. The water surface profiles of Spearman Draw are included in the Appendix, pages 33 to 43. An index is included in the Appendix page 5, to assist the user in relating the flood hazard area photomaps to the appropriate water surface profile.

Cross sections, representative of the streams studied, have been plotted to illustrate the shape of that stream and its flood plain. The 10-year, 50-year, 100-year, and 500-year floodwater surface elevations are shown on the plotted cross section to illustrate the effect of various flood depths (see Appendix, page 45).

The elevations, discharges and flood plain width of the 10-year, 50-year, 100-year and 500-year floods at surveyed cross sections are shown in

Appendix Table 2. Each cross section is listed by number on this table. Each cross section is also identified by number on flood hazard area photomaps. The user can locate a cross section on the photomap, turn to Table 2, (Appendix, page 47) and read the discharge, elevation, and flood plain width directly from the table.

Also, included in the Appendix is a list of elevation reference marks showing the elevation and location of each. Additional data are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

GLOSSARY

Channel -- A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel Bottom -- The elevation of the deepest part of a stream channel at a particular cross section.

Channel Modification -- The modification of the flow characteristics of a channel by clearing, excavation, realignment, lining, or other means to increase its capacity; sometimes used to connote channel stabilization.

Flood -- An overflow or inundation that comes from a river or other body of water and causes or threatens damage.

Flood Frequency -- A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative stream flow or rainfall and runoff records. A 10-year frequency flood would have an average frequency of occurrence in the order of once in 10 years (a ten percent chance of being equaled or exceeded in any given year). A 50-year frequency flood would have an average frequency of occurrence in the order of once in 50 years (a two percent chance of being equaled or exceeded in any given year). A 100-year frequency flood would have an average frequency of occurrence in the order of once in 100 years (a one percent chance of being equaled or exceeded in any given year). A 500-year frequency flood would have an average frequency of occurrence in the order of once in 500 years (a 0.2 percent chance of being equaled or exceeded in any given year).

Flood Peak -- The highest value of the stage or discharge attained by a flood, thus, peak stage or peak discharge.

Flood Plain -- 1. Nearly level land situated on either or both sides of a channel which is subject to overflow flooding. 2. Lowland and relatively flat alluvial areas adjoining inland and coastal waters (streams, bays, etc.), including flood-prone areas of off shore islands.

500-Year Flood Plain -- The land that would be flooded on an average of once every 500 years.

100-year Flood Plain -- The land that would be flooded on an average of once every 100 years.

Flood Profile -- A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage -- The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured.

High Water Mark (HWM) -- The maximum observed and recorded height or elevation that floodwater reaches during a storm, usually associated with the flood peak. The high water mark may be referenced to a particular building, bridge or other landmark, or based on debris deposits on bridges, fences, or other evidence of the flood.

Low Bank -- The highest elevation of a specific channel cross section at which the water will be contained without overflowing onto adjacent flood plain areas.

Runoff -- That portion of the precipitation on a drainage area that is discharged from the area in stream channels; types include surface runoff, groundwater runoff, or seepage.

Structural Bottom of Opening -- The lowest point of a culvert or bridge opening with a constructed bottom through which a stream flows that could tend to limit the stream channel bottom to that specific elevation. This structural bottom may be covered with sediment or debris which further restricts the size of the opening.

Top of Opening -- The lowest point of a bridge, culvert, or other structure over a river, stream or watercourse that limits the height of the opening through which water flows. This is referred to as "low steel" or "low chord" in some regions.

Water Surface Profile -- A graph showing the relationship of water surface elevation to stream channel location for a specific flood event.

Watershed -- All land and water within the confines of a drainage divide.

Watershed Boundary -- The divide separating one drainage basin from another.

BIBLIOGRAPHY

A Computer Program for Project Formulation, Hydrology, Technical Release No. 20, U.S. Department of Agriculture, Soil Conservation Service, March 1969.

Flood Hazard Evaluation Guidelines for Federal Executive Agencies, United States Water Resources Council, May 1972.

Flood Insurance Study Guidelines, U.S. Department of Housing and Urban Development, Federal Insurance Administration, April 1974.

Floodway Determination Computer Program, Technical Release No. 64, U.S. Department of Agriculture, Soil Conservation Service, June 1978.

Gould, F.W., 1975, Texas Plants -- A Checklist and Ecological Summary, Misc., Publ., 585/revised, Texas Agricultural Experiment Station, College Station, Texas.

Hydraulics of Bridge Waterways, U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, Second Edition, September 1973.

National Engineering Handbook, Section 4, Hydrology, U.S. Department of Agriculture, Soil Conservation Service, 1972.

National Engineering Handbook, Section 5, Hydraulics, U.S. Department of Agriculture, Soil Conservation Service, 1956.

Rainfall Frequency Atlas of the United States, Technical Paper No. 40, U. S. Weather Bureau, May 1961.

Regulations of Flood Hazard Areas, Volumes 1 and 2, United States Water Resources Council.

Resource Conservation Glossary, 3rd Edition 1982, SCSA, Ankeny, Iowa 50021.

Shaw, S.P. and C.G. Fredine, 1971, Wetlands of the United States, Circular 39, USDI, Fish and Wildlife Service, Washington, D.C.

Soil Survey of Hansford County, Texas, USDA, Soil Conservation Service, June 1960.

Soil Survey of Hutchinson County, Texas, USDA, Soil Conservation Service, November 1976.

WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates, Technical Release No. 61, U.S. Department of Agriculture, Soil Conservation Service, May 1976.

APPENDIX

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TECHNICAL APPENDIX

This Technical Appendix to the city of Spearman Flood Plain Management Study Report is a compilation of the FPMS technical findings. It includes the photomap index, flood hazard area photomaps, flood profiles, plottings of typical stream cross sections, elevation and discharge tabulations and a listing of pertinent elevation reference marks. Other technical data developed during this study are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

INVESTIGATIONS AND ANALYSES

FIELD SURVEYS

Topographic data were obtained from Geological Survey topographic maps and field surveys. Engineering surveys were made of cross sections selected to represent the stream hydraulics and flood plain areas (refer to the sheets of typical valley cross section, Appendix, page 45). Elevations appearing in this report are based on mean National Geodetic Vertical Datum of 1929. Temporary elevation reference marks were established by Deni Associates, Inc. in 1984. Table 3 Appendix, pages 48 to 49, shows the listings, descriptions, and location of permanent and temporary elevation reference marks.

HYDROLOGIC AND HYDRAULIC METHODS

The watershed boundaries were determined by use of Geological Survey topographic maps. The top of the watershed begins approximately 16

miles southwest of the Spearman city limits. Hydraulic evaluations were based on synthetic frequency methods. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Values greater than the 100-year frequency event were determined by extrapolation of the rainfall versus frequency graph. Peak discharge values were determined by flood routing various storm frequencies with a 24-hour rainfall duration using SCS Technical Release No. 20, A Computer Program for Project Formulation, Hydrology. The program computes surface runoff resulting from any synthetic or natural rainstorm. The program will route the flow through stream channels and reservoirs. Results include, but are not limited to, a combination of the routed hydrograph with those from other tributaries and a printout of the peak discharges, their time of occurrence, and the water surface elevations for each computed discharge at any desired cross section or structure.

From the representative stream and road cross sections, water surface profiles were developed by the Modified Slope Area Method. The effects of bridges and culverts on the stream hydraulics were determined by use of the Bureau of Public Roads (BPR) Method. Computations were made using SCS's "WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates."

Using the output data from this program, rating curves were plotted for each cross section. These curves show the relationship between stage or elevation and discharge. Water surface profiles were developed from these rating curves and the computer results of TR-20 routings.

FLOOD HAZARD EVALUATION

The 500-year and 100-year frequency flood hazard areas are outlined on aerial photographs obtained from the January 1981 Agricultural Conservation and Stabilization Service flight. The flood hazard area boundaries were developed by plotting the computed water surface elevations on the surveyed cross sections and transposing this information to the aerial photographs. The flood hazard areas between the surveyed cross sections were developed through interpretation of Geological Survey topographic maps and the aerial photographs in conjunction with the surveyed cross sections. Actual flood limits may vary slightly on the ground from the outlined area on the photomaps due to map scale and reproduction limitations. For this reason, the water surface elevations from the flood profiles should be used for determining site specific potential flood depths.

ESTIMATES OF FLOOD LOSSES

The number and type of buildings located within the delineated flood hazard areas were determined by Soil Conservation Service personnel through on-the-ground reconnaissance and interviews with local people.

INVENTORY OF NATURAL VALUES

The natural values of the study area flood plain were determined by the Soil Conservation Service, Basin and Area Planning staff biologist through on-the-ground reconnaissance, interviews of local people and literature search.

PUBLIC PARTICIPATION

The city of Spearman Flood Plain Management Study Plan of Work was developed through consultation with the local officials and study endorsers.

A public meeting was held during preparation of the report draft in order to get public input and participation.

MANAGEMENT ALTERNATIVES

Nonstructural management alternatives were considered during the flood plain management study and discussed during meetings with local public officials and other interested members of the public. Those considered to have merit and worthy of further study for possible implementation were put in the report.

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TO

CITY OF SPEARMAN FLOOD PLAIN MANAGEMENT STUDY

FLOOD HAZARD AREA PHOTOMAPS
AND
WATER SURFACE PROFILES

Cross Section Number	Flood Hazard Area Photomap Sheet Number	Water Surface Profile Sheet Number	Cross Section Number	Flood Hazard Area Photomap Sheet Number	Water Surface Profile Sheet Number
1	1, 2	1	15	11, 12	5, 6
2	1, 2	1	16	12	6
3	1, 2, 3,4,5	1			
4	5, 6	2			
5	5, 6	2			
6	5, 6	2			
7	5, 6	2			
8	5, 6, 7, 8	2			
9	7, 8	3			
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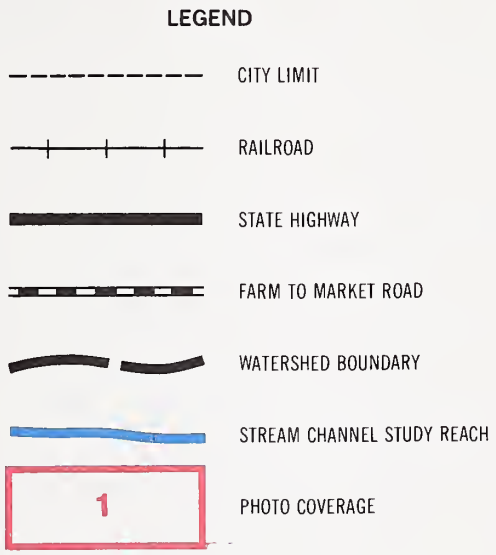
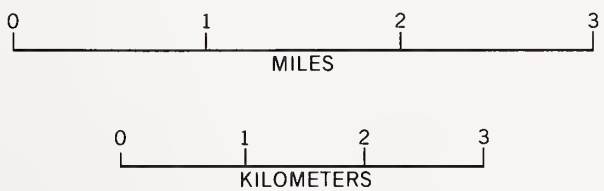
14	11, 12	4, 5			



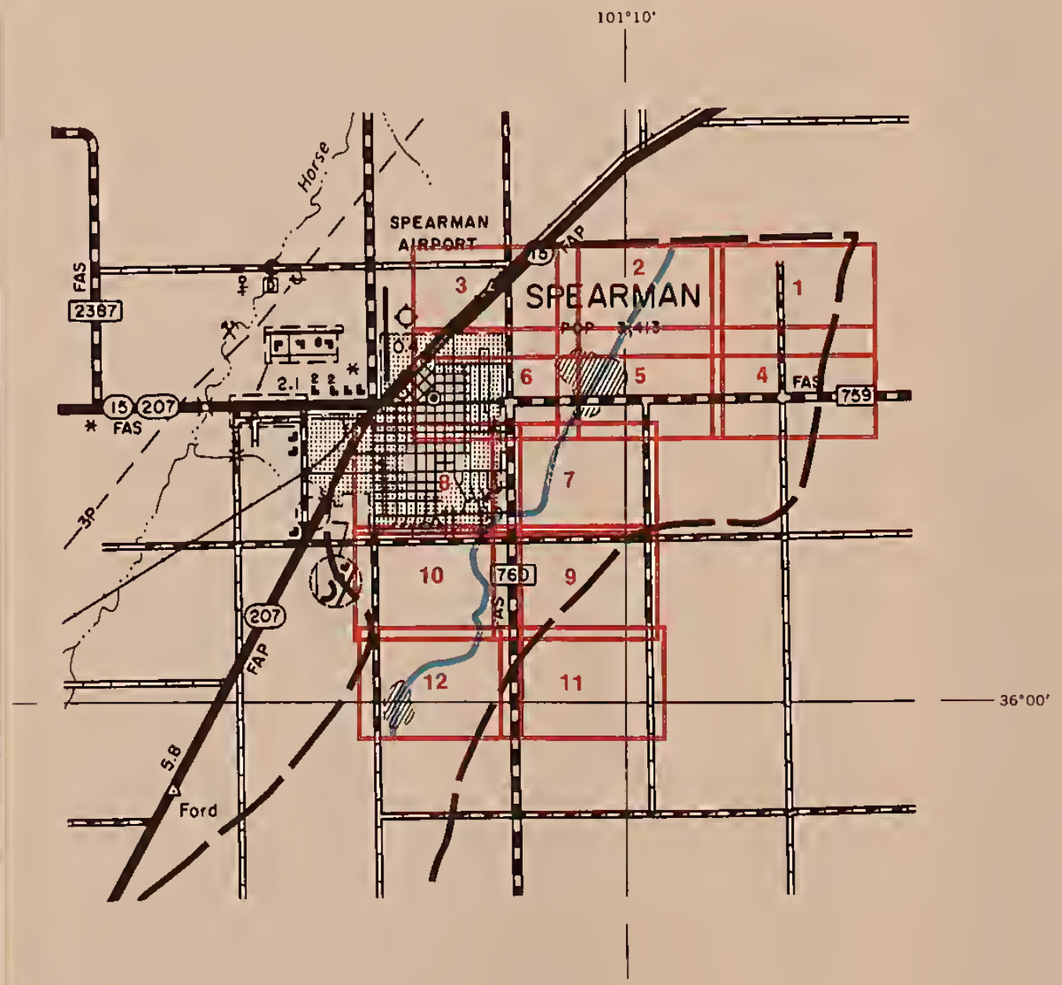
INDEX MAP

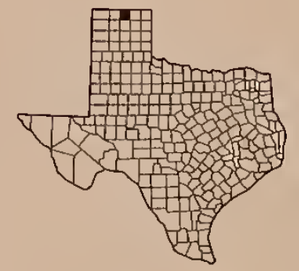
FLOOD PLAIN MANAGEMENT STUDY AREA CITY OF SPEARMAN

HANSFORD COUNTY, TEXAS



APRIL 1986 4-R-38815





VICINITY MAP

LEGEND

- CITY LIMIT
- RAILROAD
- STATE HIGHWAY
- FARM TO MARKET ROAD
- WATERSHED BOUNDARY
- STREAM CHANNEL STUDY REACH
- 1 PHOTO COVERAGE

INDEX MAP

FLOOD PLAIN MANAGEMENT STUDY AREA CITY OF SPEARMAN

HANSFORD COUNTY, TEXAS

0 1 2 3 MILES

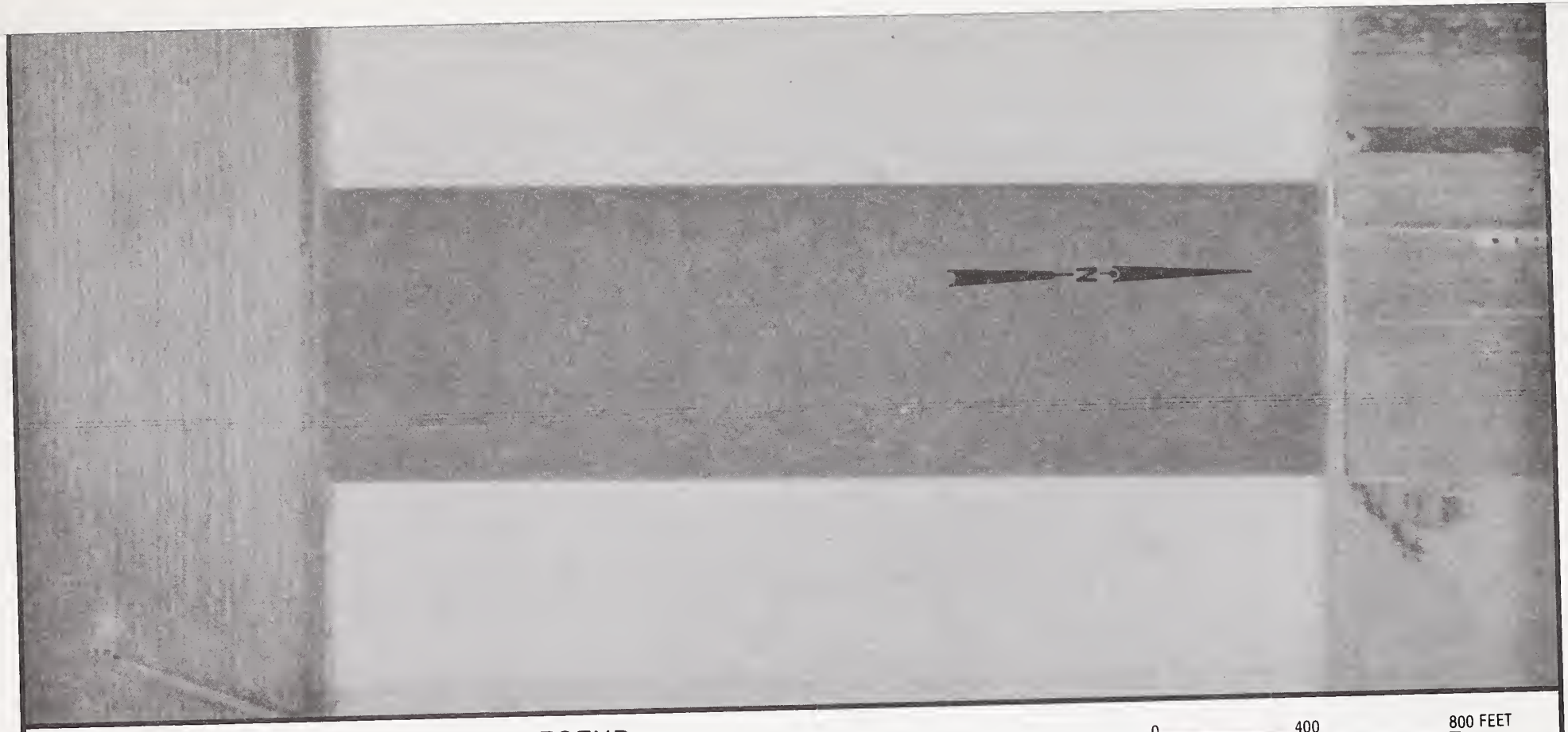
0 1 2 3 KILOMETERS

N

Source: County Highway Map
Polyconic Projection

USDA-SCS-NATIONAL MAPPING DIVISION, FT WORTH, TX 1986

APRIL 1988 4-R-38815



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

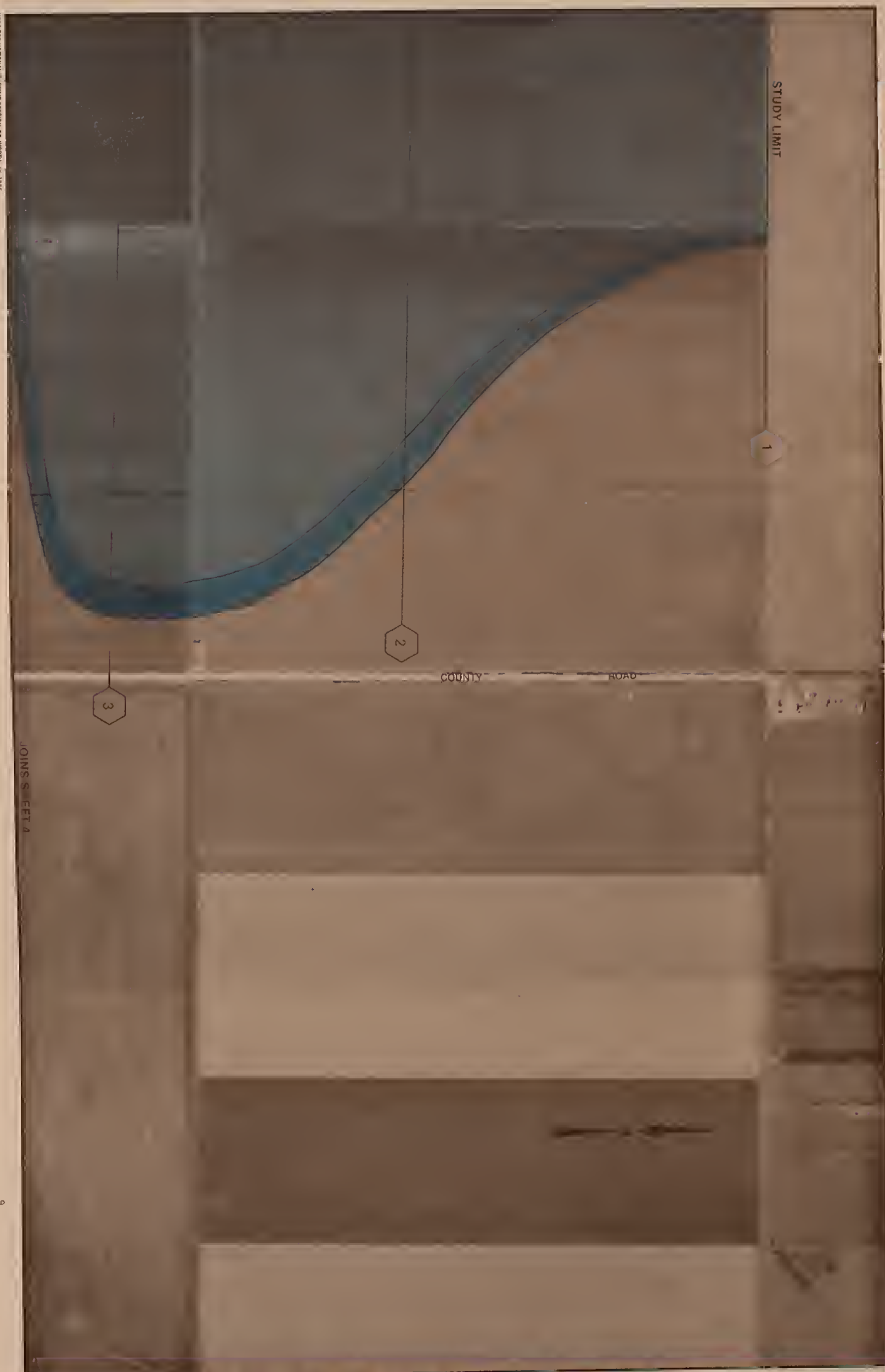
A.S.C.S. Photography 1/21/81

SHEET 1 OF 12

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- Elevation Reference Marks
- 1400 → Channel Station

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SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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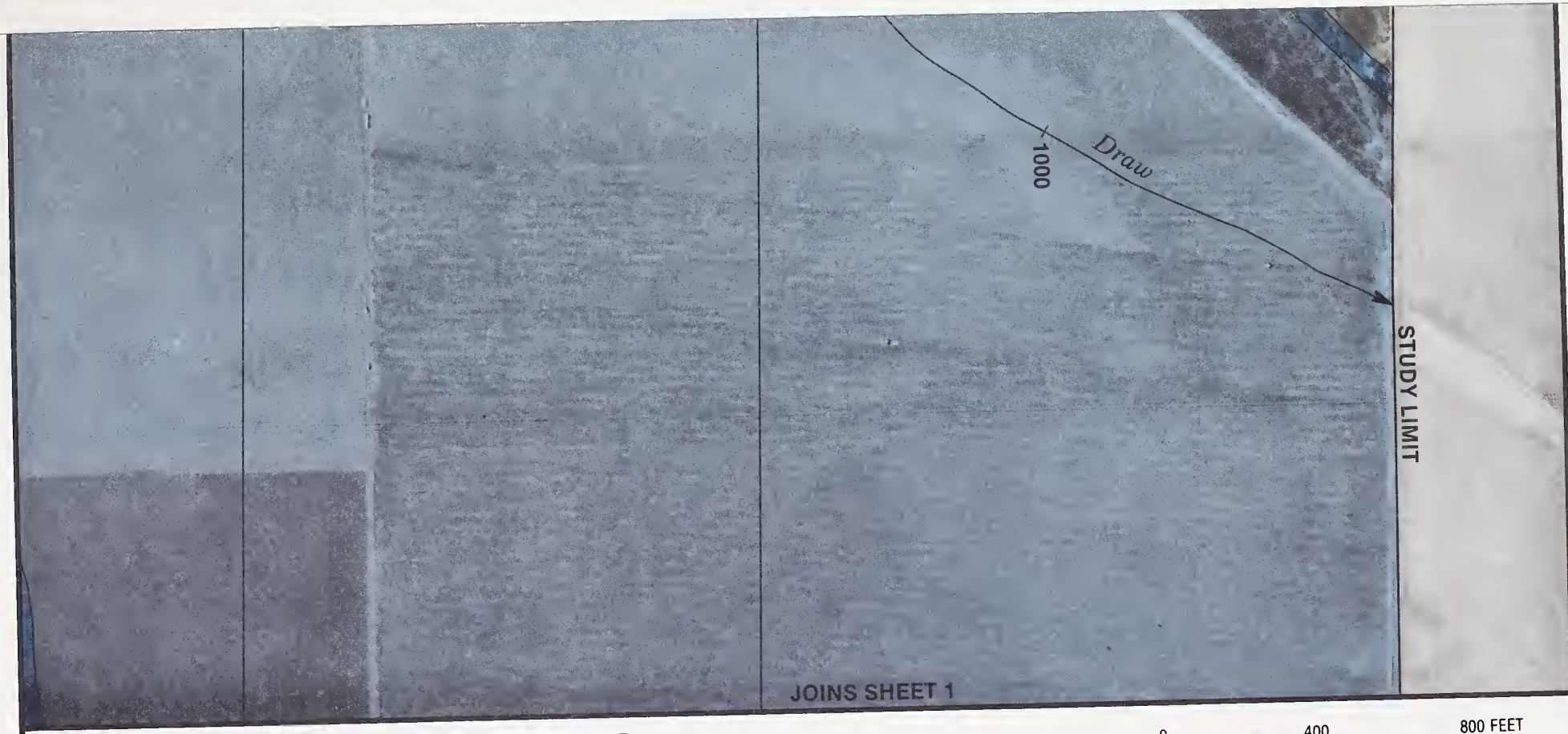
FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 → Channel Station

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SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 1/21/81

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FLOOD HAZARD AREA

SPEARMAN DRAW

JOINS SHEET 3

3

2

N

4000

3000

2000

1000

Spearman

Draw

ERM 13

X

1

JOINS SHEET 5

STUDY LIMIT

SHEET

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 — Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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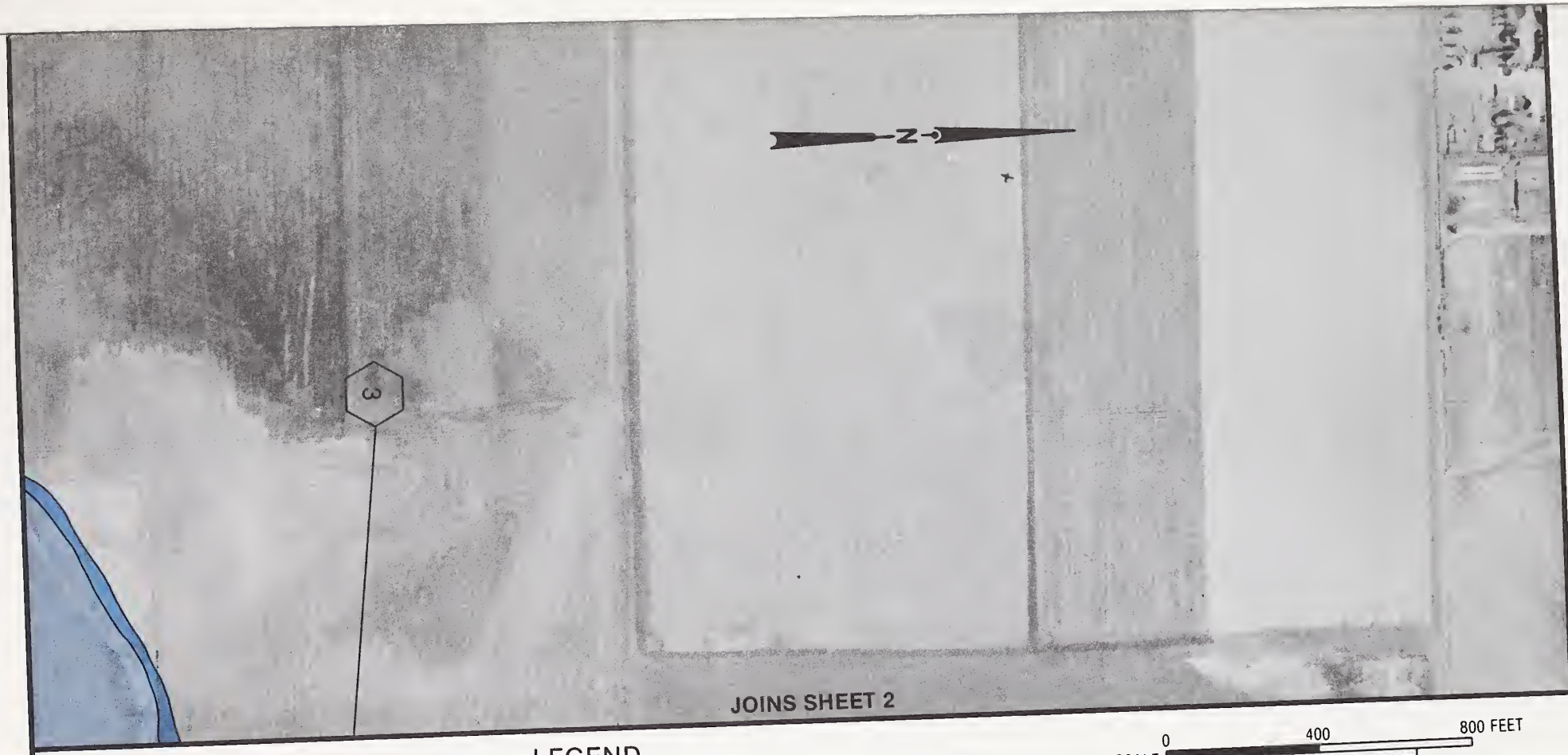
FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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U.S. DEPARTMENT OF AGRICULTURE
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HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

USDA SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1986

LANDING STRIP

SEA MAN

N. HAZELWOOD ST.

CITY

N. JAMES ST.

LIMIT

N. SNIDER ST.

SANTA FE AND PANHANDLE RAILROAD

FM 15

ERM 7

X

COUNTY ROAD

JOINS SHEET 6

JOINS SHEET 2

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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CITY OF SPEARMAN
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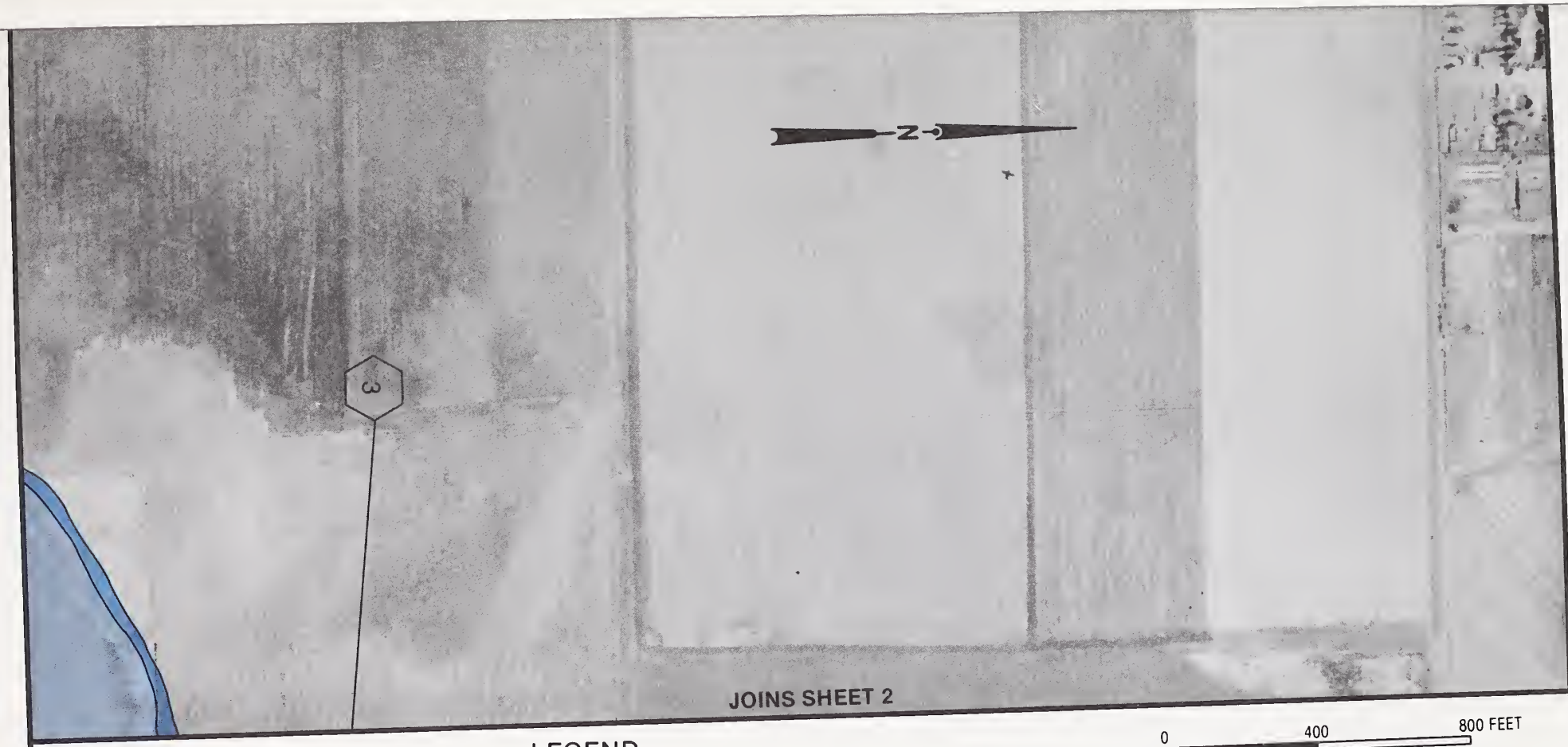
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

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HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

USDA SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1980

LANDING STRIP

SPEARMAN

CITY LIMIT

N. HAZELWOOD ST.

N. JAMES ST.

N. SNIDER ST.

SANTA FE AND PANHANDLE RAILROAD

FM 15

ERM 7 X

COUNTY ROAD

JOINS SHEET 6

JOINS SHEET 2

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
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- Stream Channel
- X Elevation Reference Marks
- 1400 Channel Station

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SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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HANSFORD COUNTY, TEXAS

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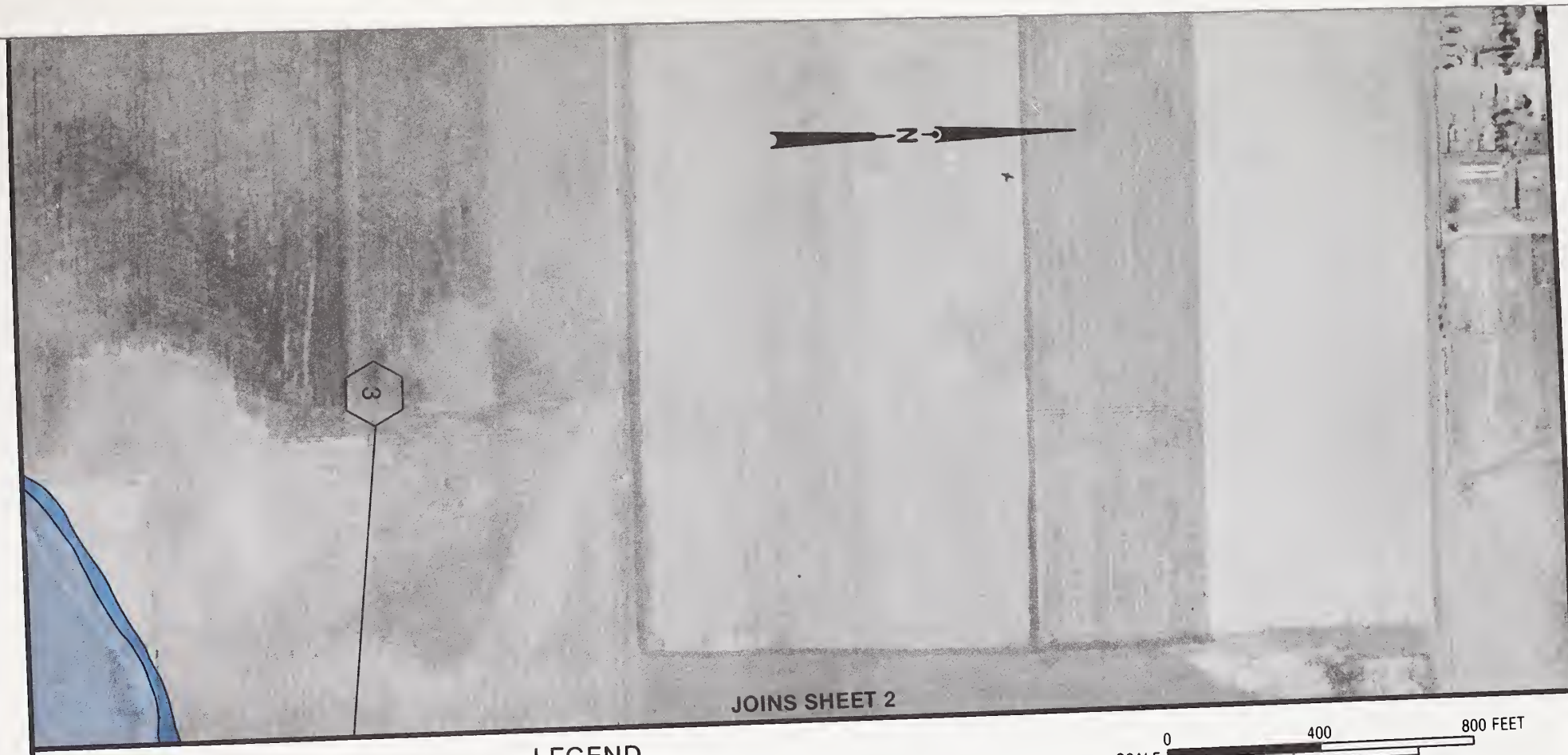
FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

Elevation Reference Marks

1400 Channel Station

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SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 1/21/81

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FLOOD HAZARD AREA

SPEARMAN DRAW

USDA SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1985

LANDING STRIP

S. ARMAN

N. HAZELWOOD ST.

CITY

LIMIT

SANTA FE AND PANHANDLE RAILROAD

FM 15

N. JAMES ST.

N. SNIDER ST.

ERM 7

X

COUNTY ROAD

JOINS SHEET 6

Z

3

JOINS SHEET 2

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

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APPROXIMATE

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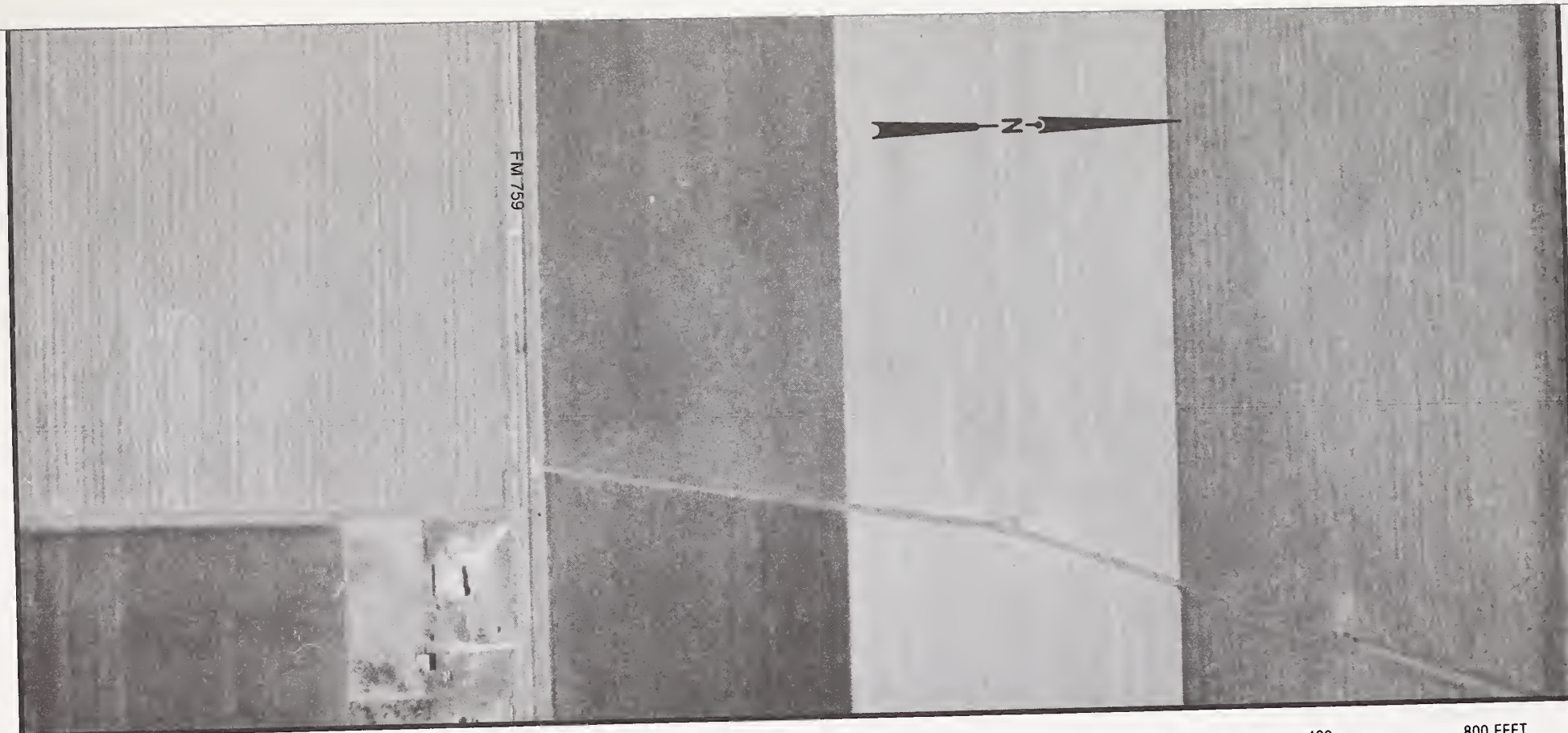
SPEARMAN DRAW



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Cross Section Location
Stream Channel
X Elevation Reference Marks
1400 Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

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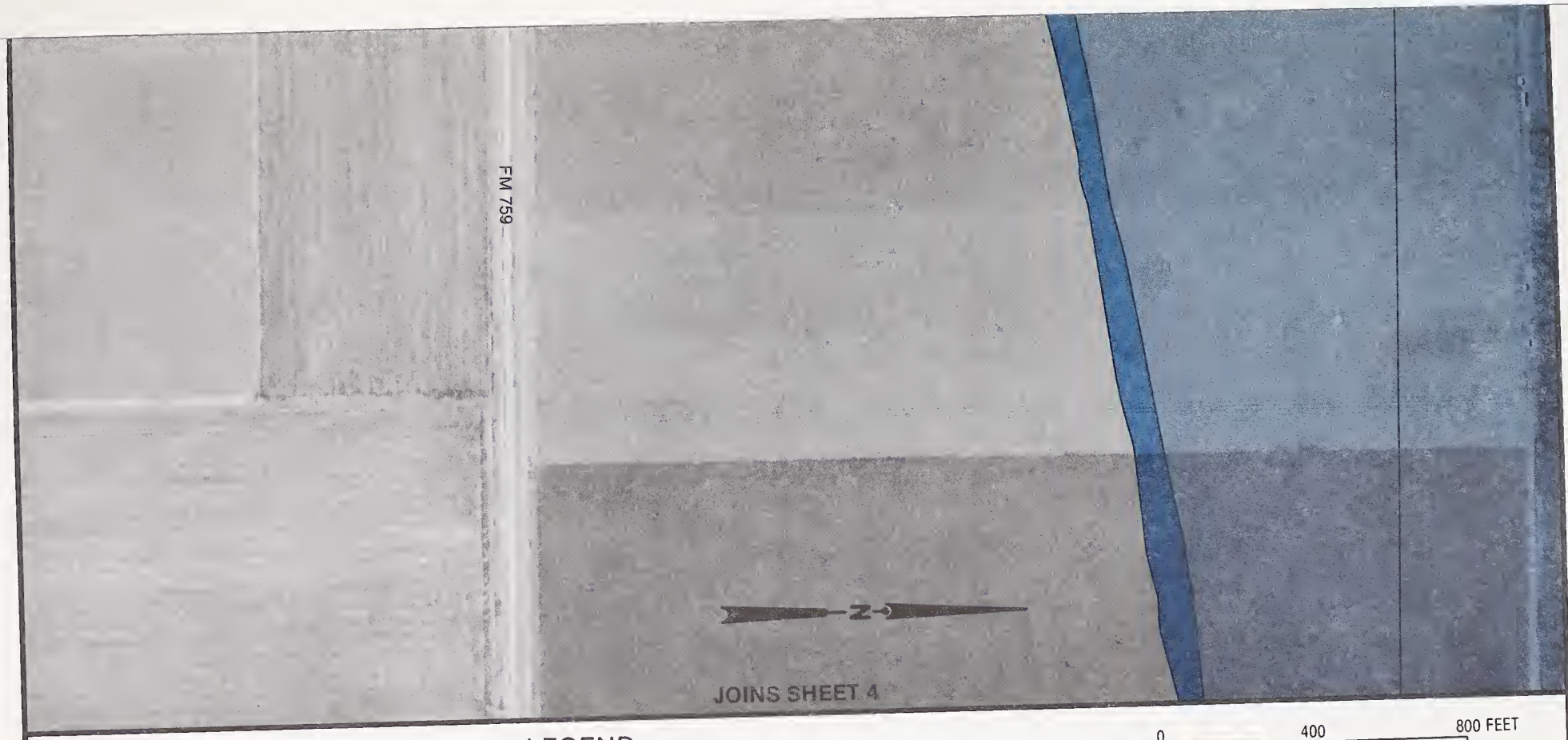
FLOOD HAZARD AREA

SPEARMAN DRAW

SHEET 4 OF 12

USDA SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1985



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X — Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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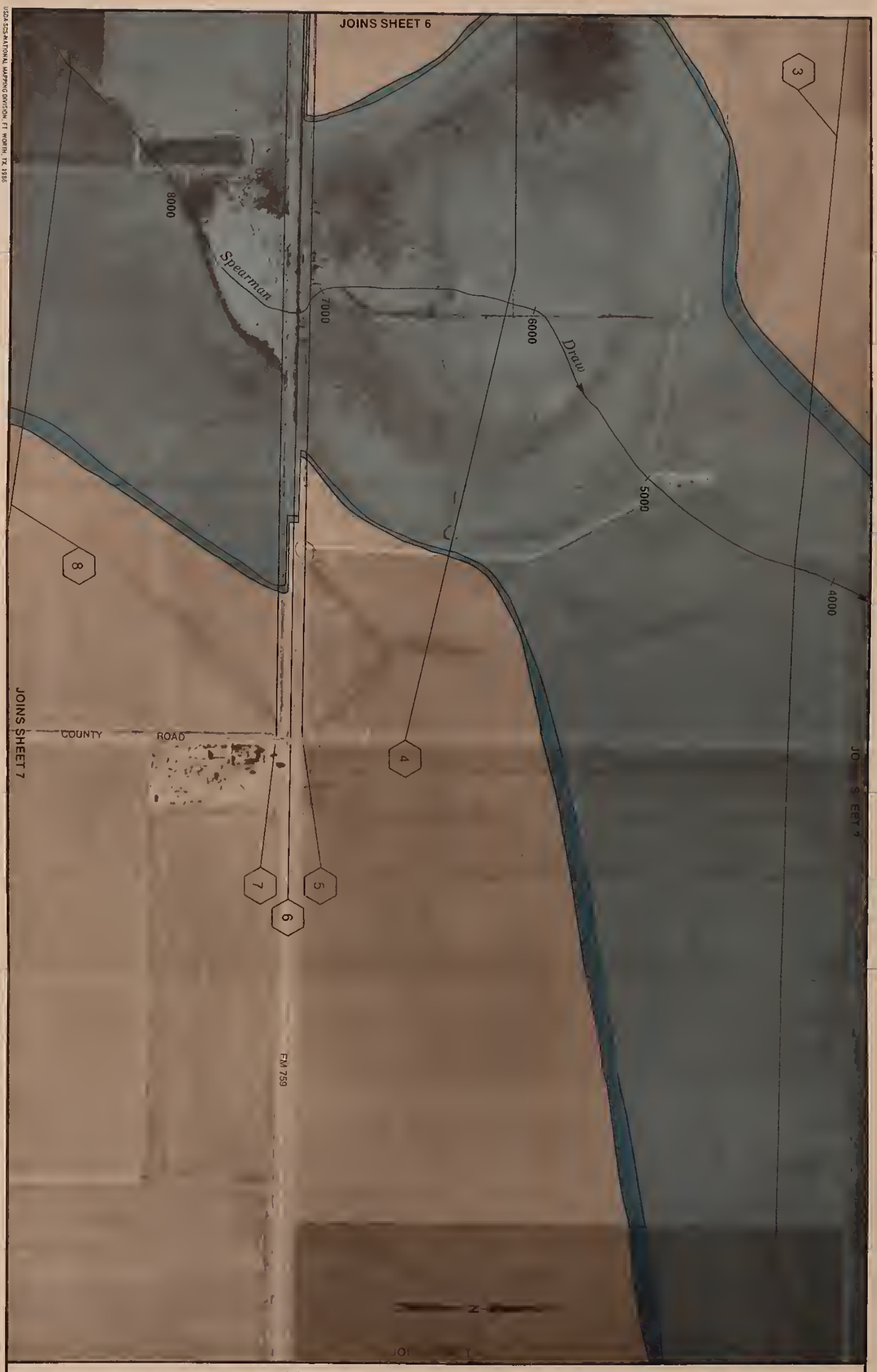
FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area
Cross Section Location
Stream Channel
Elevation Reference Marks
1400 Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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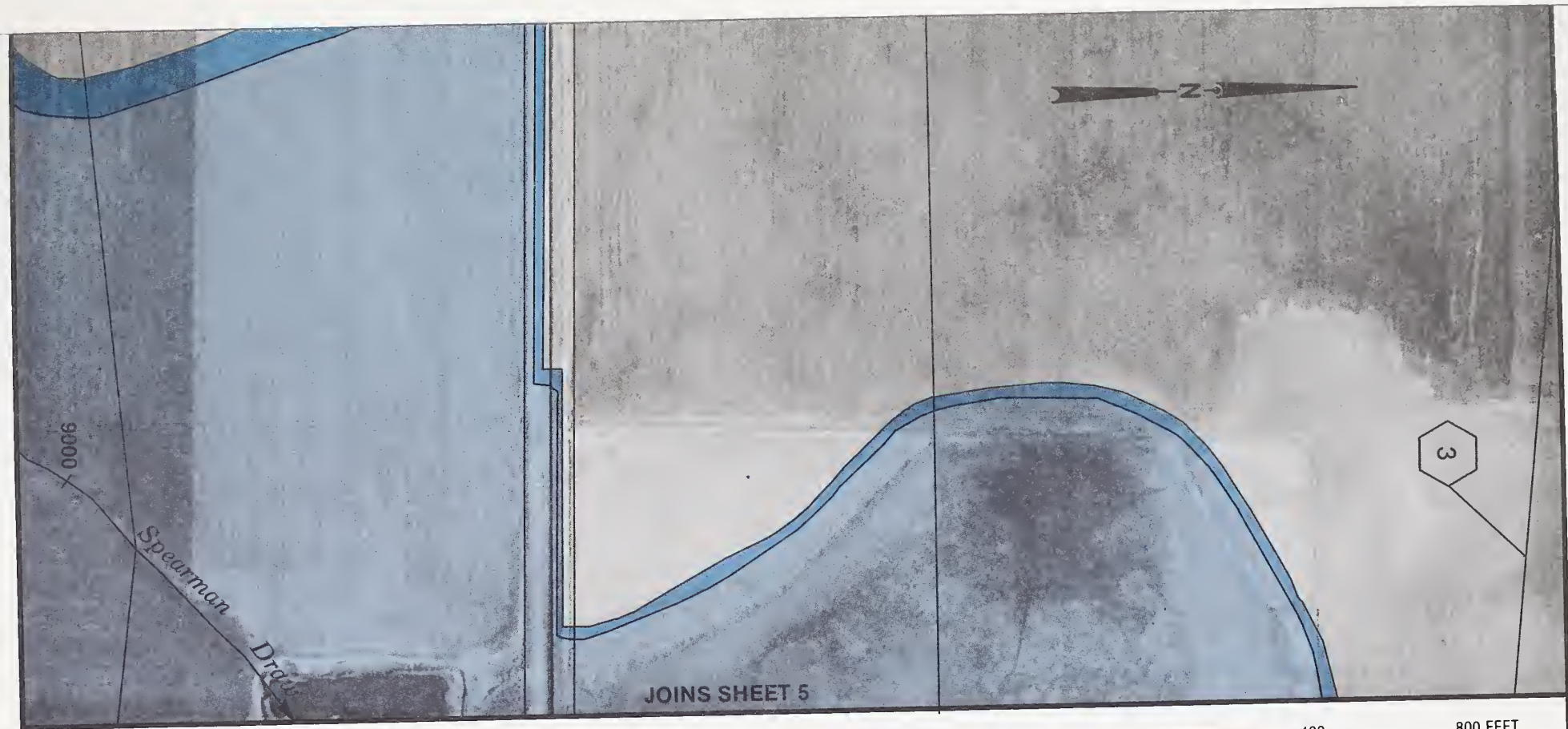
FLOOD HAZARD AREA

SPEARMAN DRAW

SHEET 5 OF 12

USDA-SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1986



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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FLOOD HAZARD AREA

SPEARMAN DRAW

LEGEND

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APPROXIMATE

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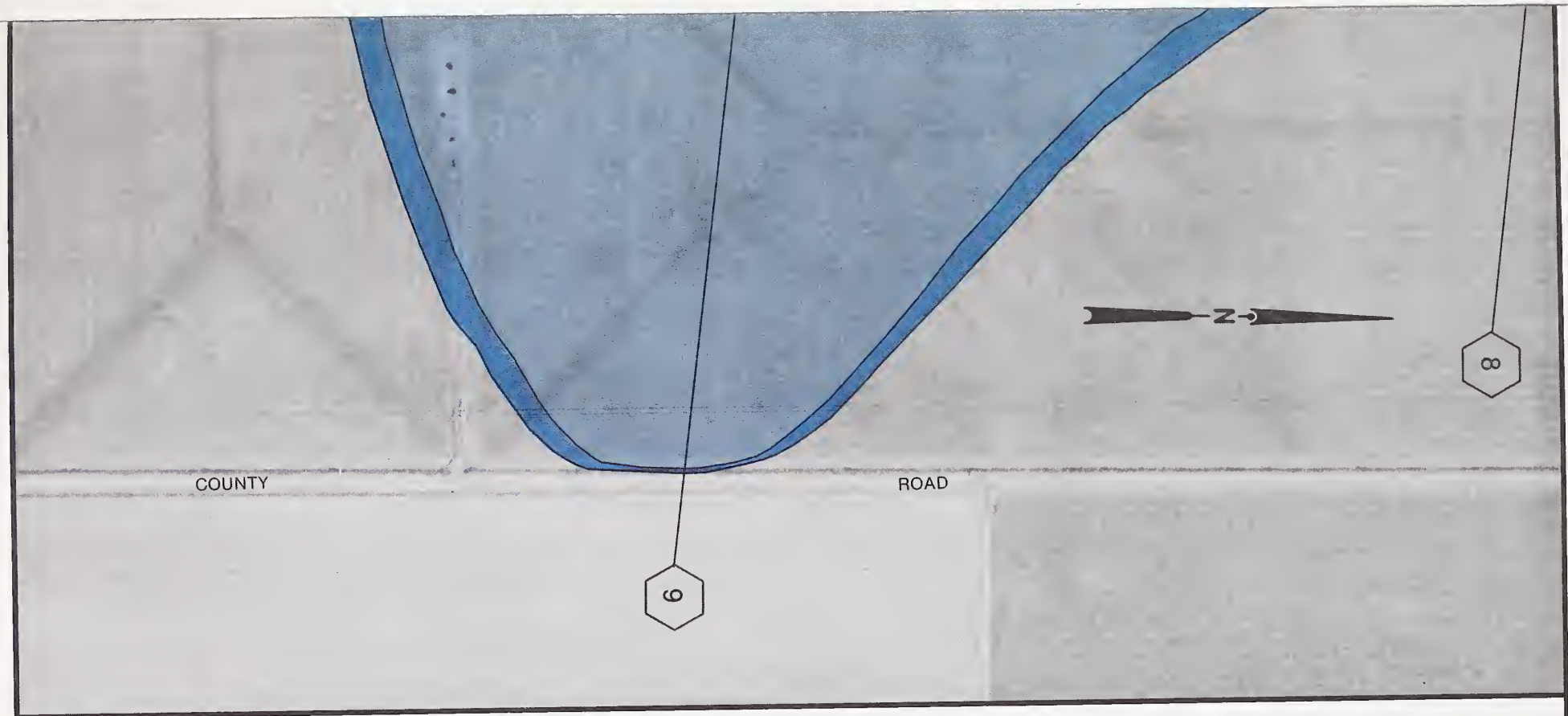
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

X Elevation Reference Marks

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Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

Elevation Reference Marks

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Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

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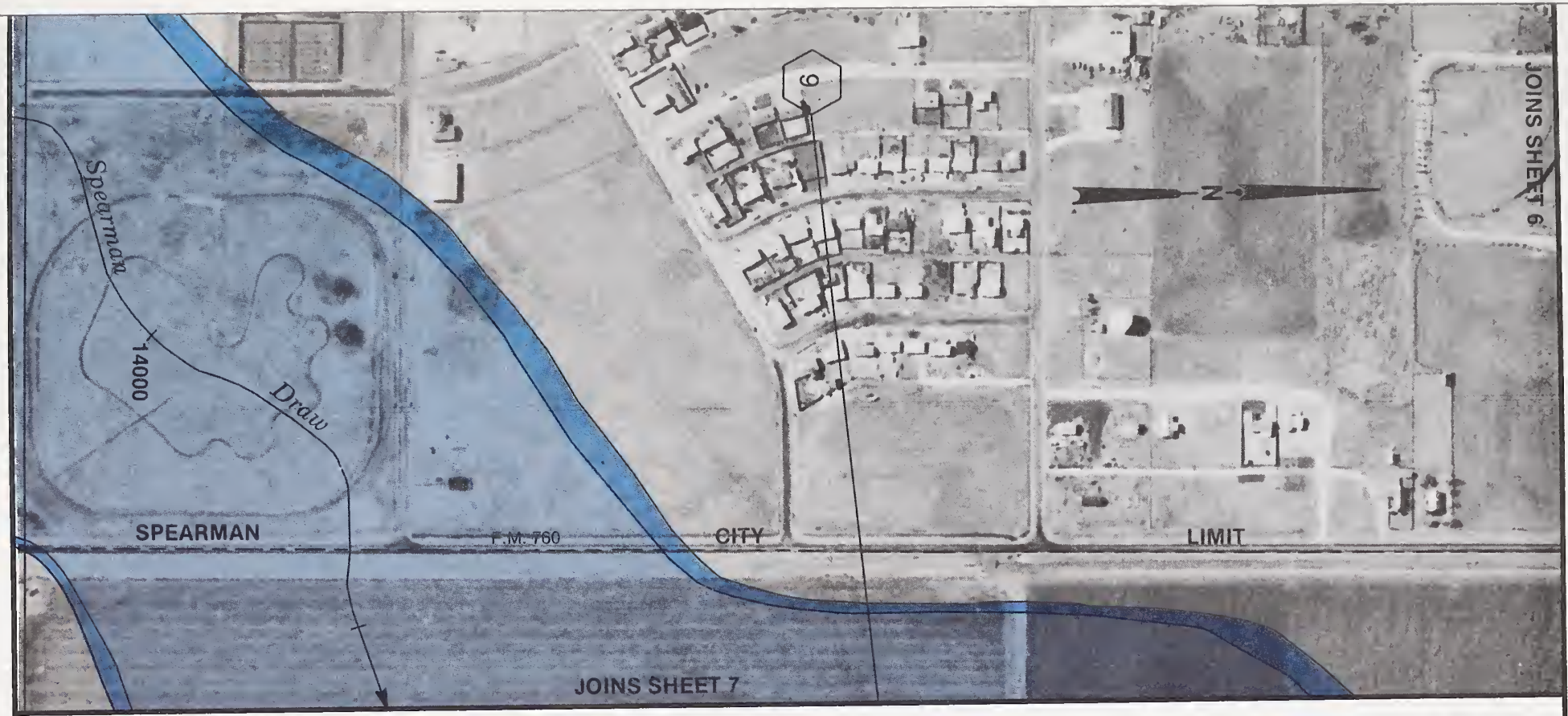
FLOOD HAZARD AREA

SPEARMAN DRAW

SHEET 7 OF 12

USDA SCS-NATIONAL MAPPING DIVISION FT WORTH, TX 1985



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A.S.C.S. Photography 1/21/81

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HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

SHEET 8 OF 12

SPEARMAN CITY LIMIT

ROLAND ST

S. ARCHER ST

S. TOWNSEND ST

S. DRESSEN ST

S. BABKLEY ST

S. HANEY ST

S. BERNICE ST

S. ELLICOTT ST

W. TWELFTH AVE

W. ELEVENTH AVE

W. TENTH AVE

W. NINTH AVE

W. EIGHTH AVE

W. SEVENTH AVE

W. FIFTH AVE

E. ELEVENTH AVE

E. SEVENTH AVE

SPEARMAN CITY LIMIT

COUNTY ROAD

JOINS SHEET 10

JOINS SHEET 6

JOINS SHEET 7

Spearman Draw

14000

9

Z

SPEARMAN CITY LIMIT

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Cross Section Location

Stream Channel

X Elevation Reference Marks

1400 Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

A.S.C.S. Photography 1/21/81

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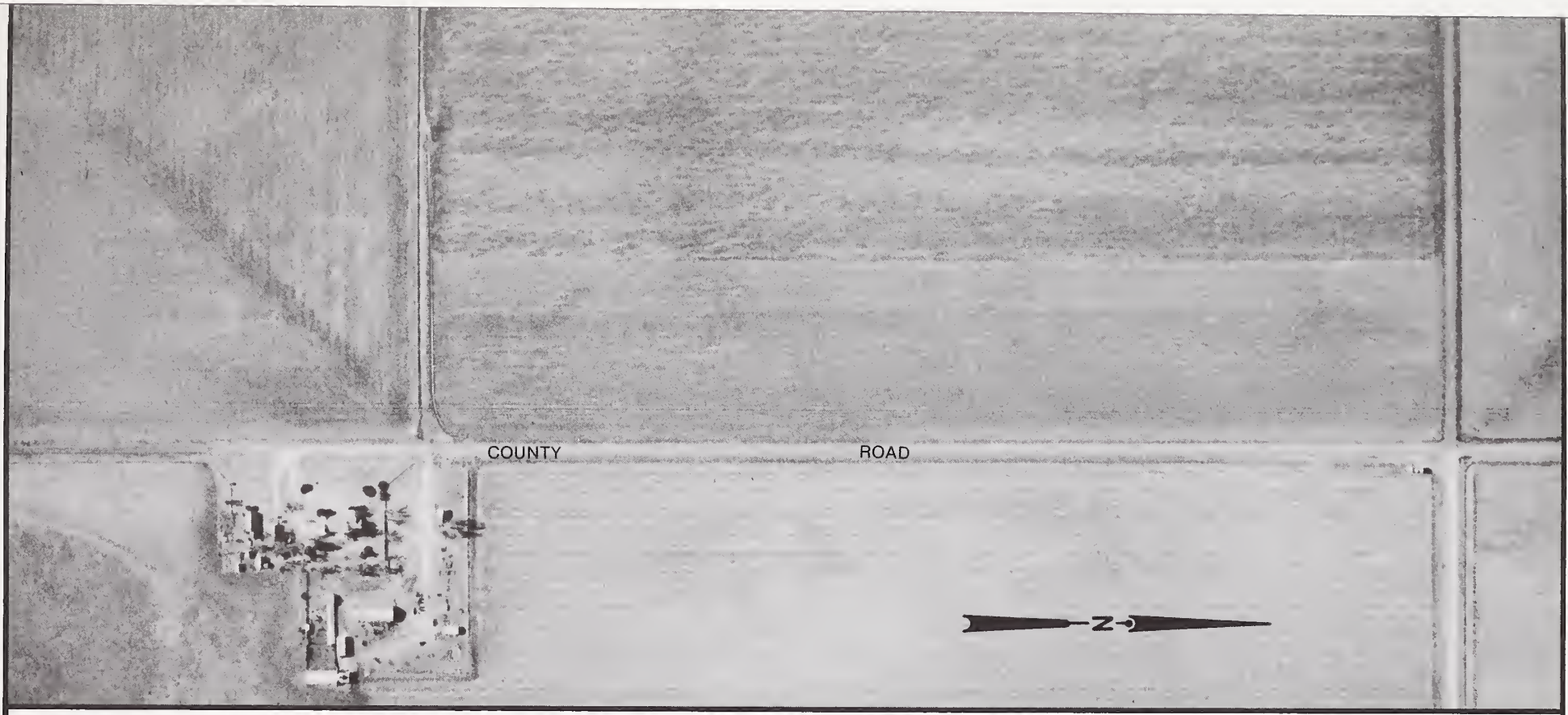
FLOOD HAZARD AREA

SPEARMAN DRAW



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100 Year Flood Hazard Area

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Cross Section Location

Stream Channel

X Elevation Reference Marks

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SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

USDA-SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1986

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
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APPROXIMATE

A.S.C.S. Photography 1/21/81

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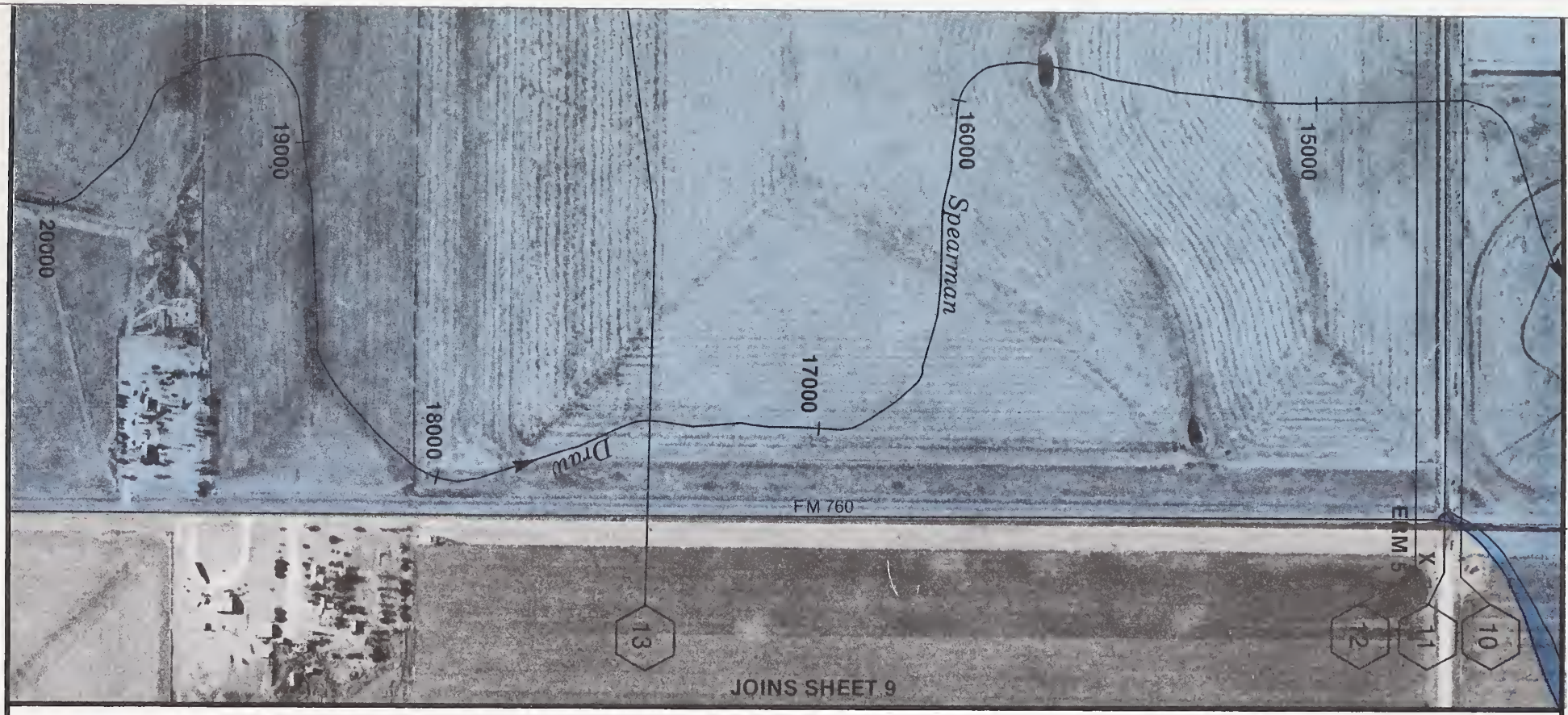
FLOOD HAZARD AREA

SPEARMAN DRAW



LEGEND

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- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

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SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

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FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

USDA-SCS-NATIONAL MAPPING DIVISION, FT. WORTH, TX. 1985

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- 100 Year Flood Hazard Area
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A.S.C.S. Photography 1/21/81

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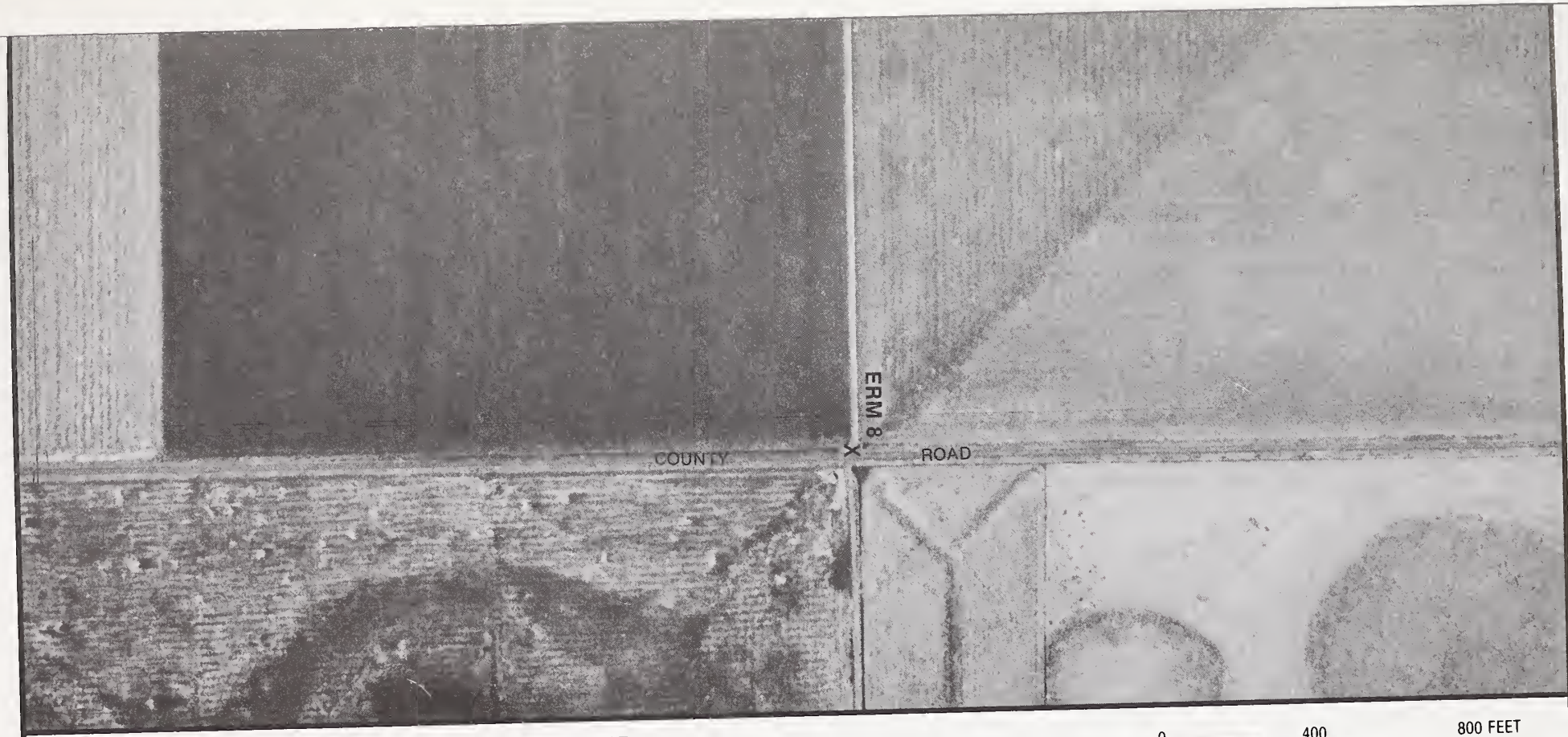
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW



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A.S.C.S. Photography 1/21/81

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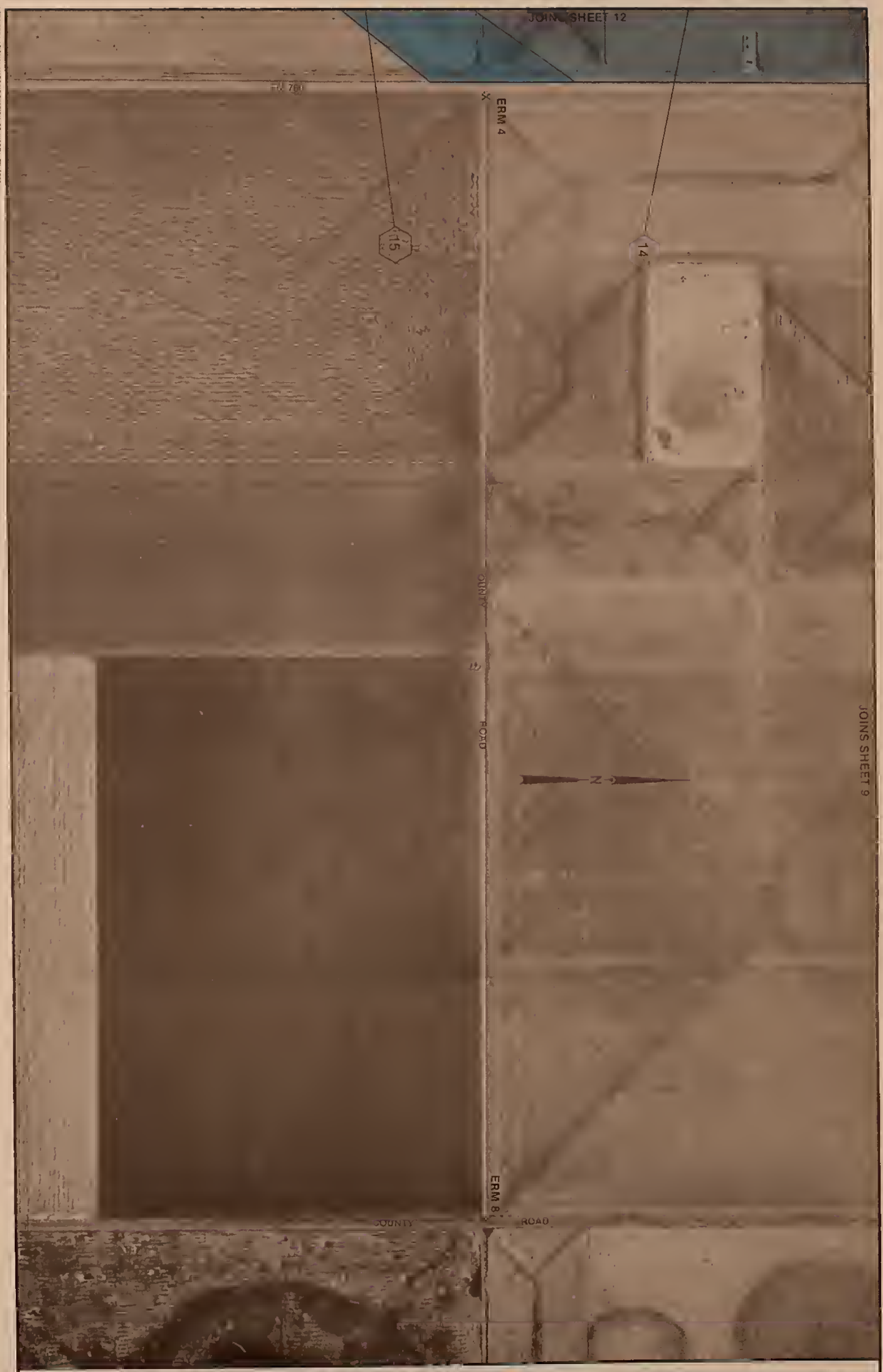
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW



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A.S.C.S Photography 1/21/81

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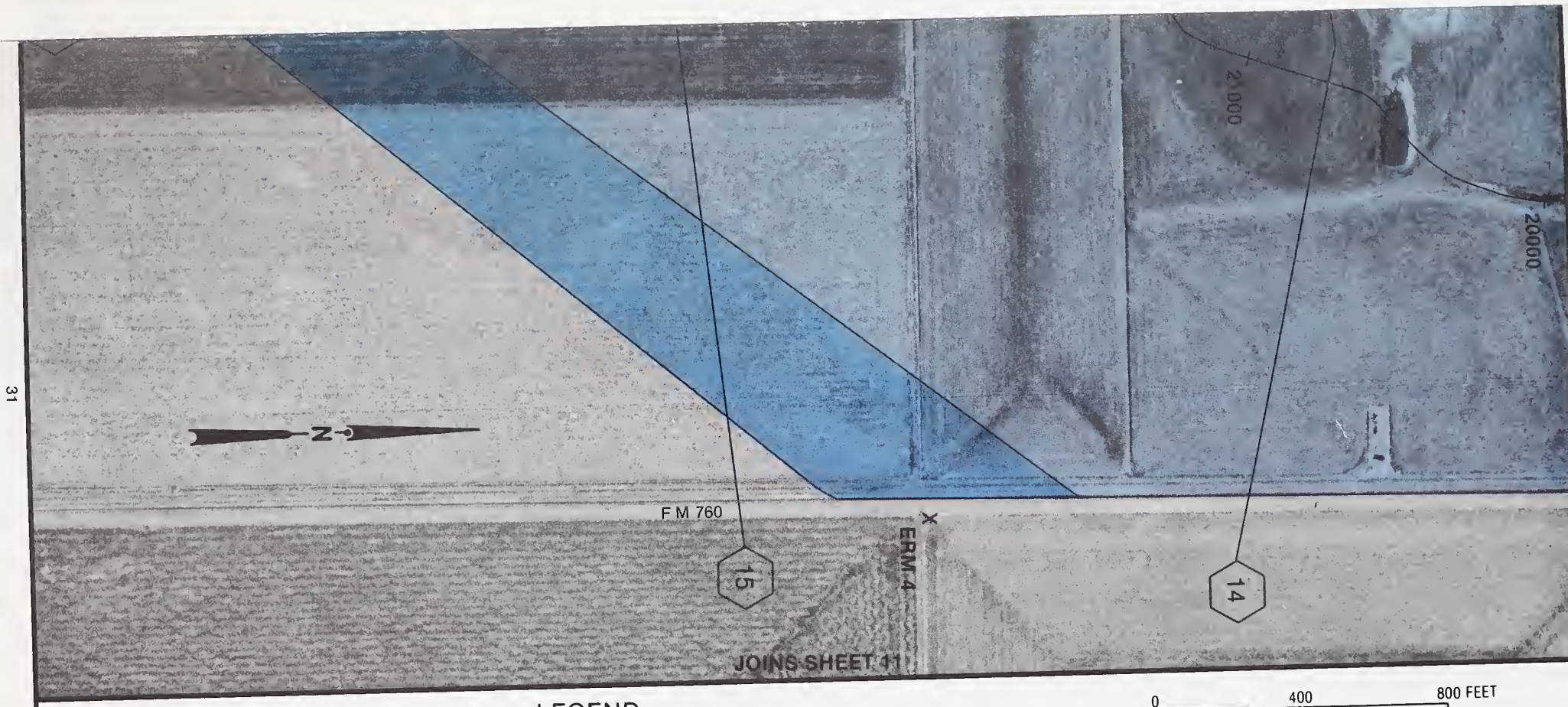
FLOOD HAZARD AREA

SPEARMAN DRAW

USDA SCS-NATIONAL MAPPING DIVISION, FT WORTH, TX. 1985



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
- X Elevation Reference Marks
- 1400 → Channel Station

Limits of flooding may vary from actual location on the ground.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

A.S.C.S. Photography 1/21/81

SHEET 12 OF 12

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- Cross Section Location
- Stream Channel
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- 1400 → Channel Station

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SHEET 12 OF 12

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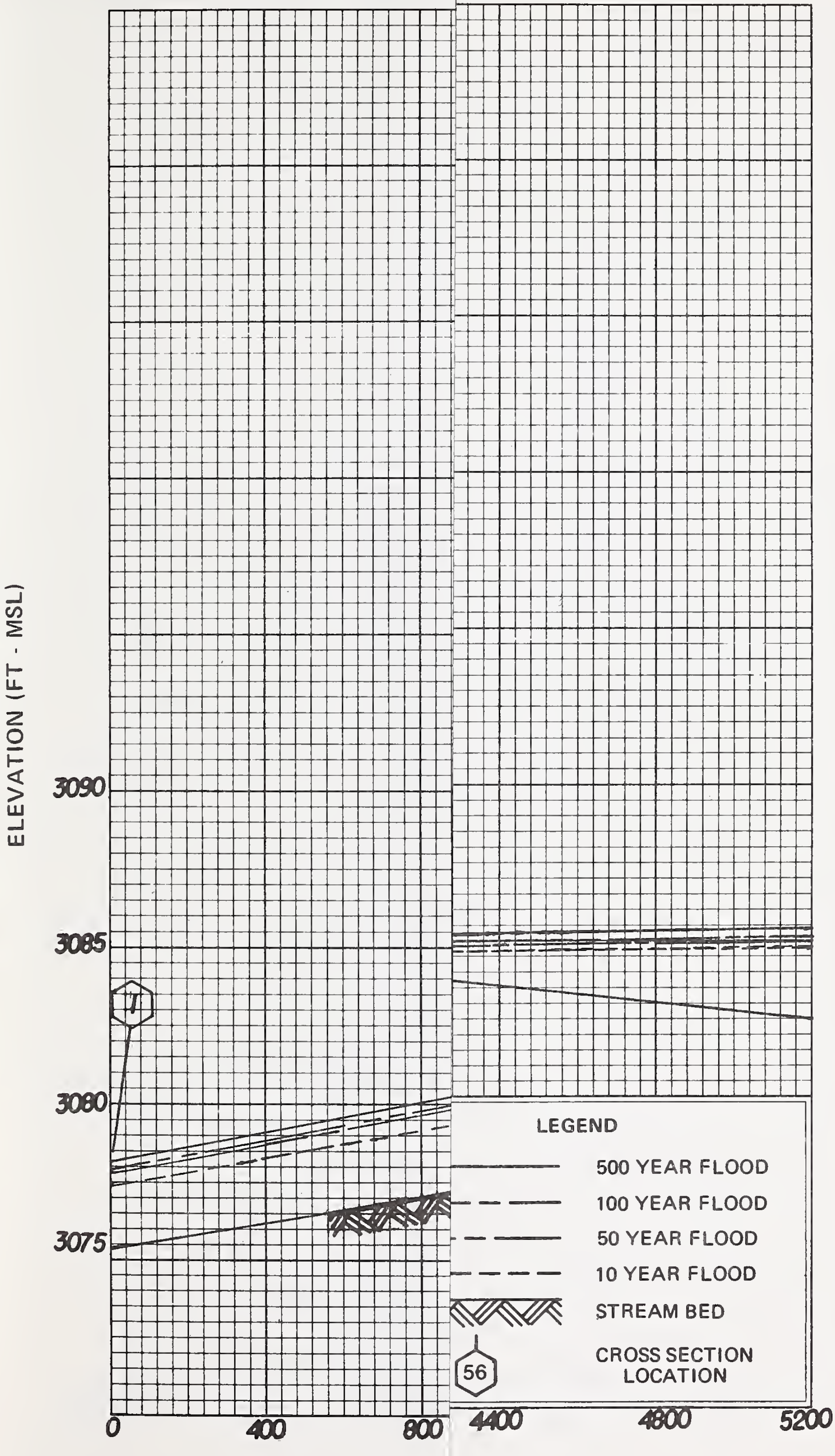
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

FLOOD HAZARD AREA

SPEARMAN DRAW



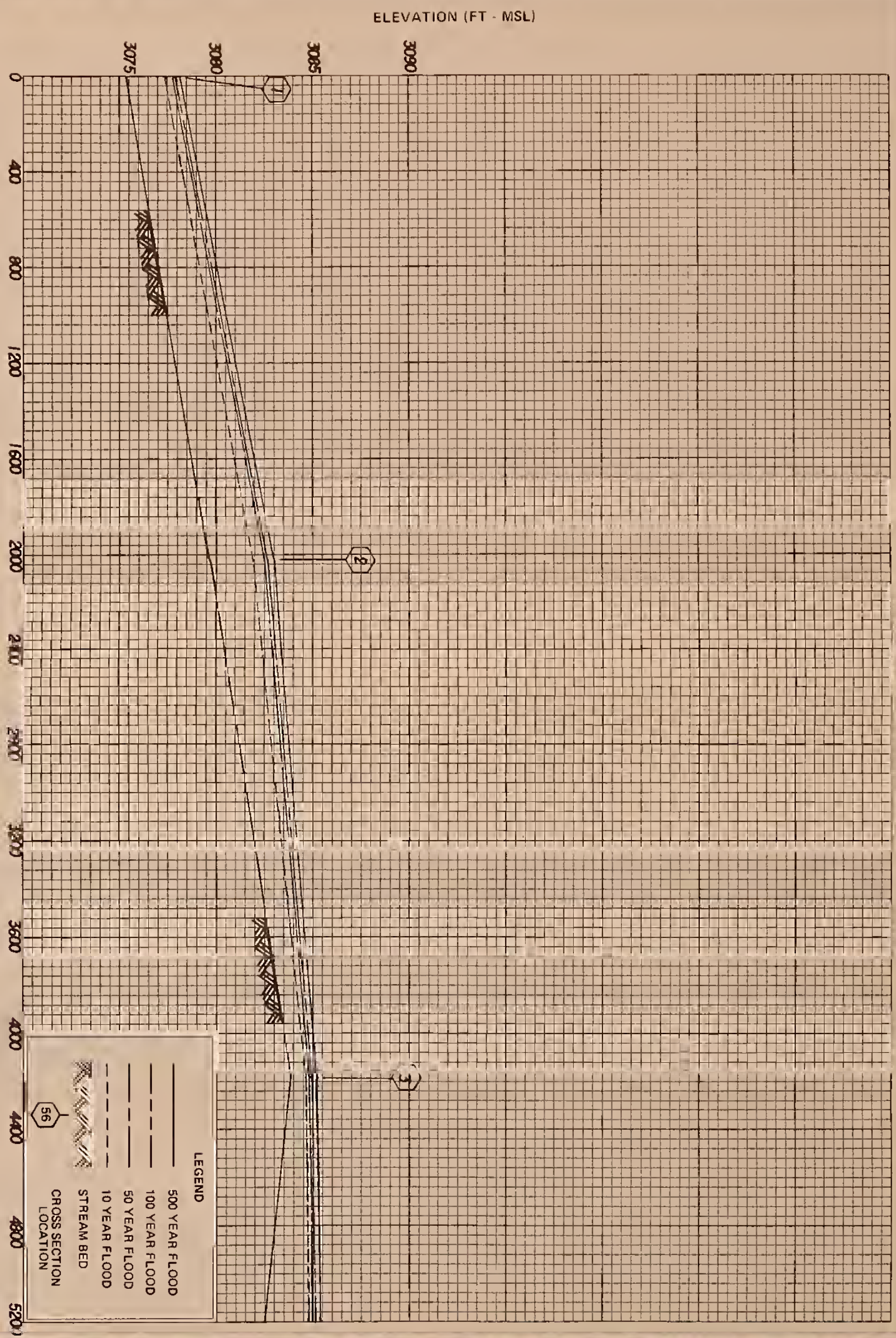
SPEARMAN DRAW

WATER SURFACE PROFILES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 1 OF 6



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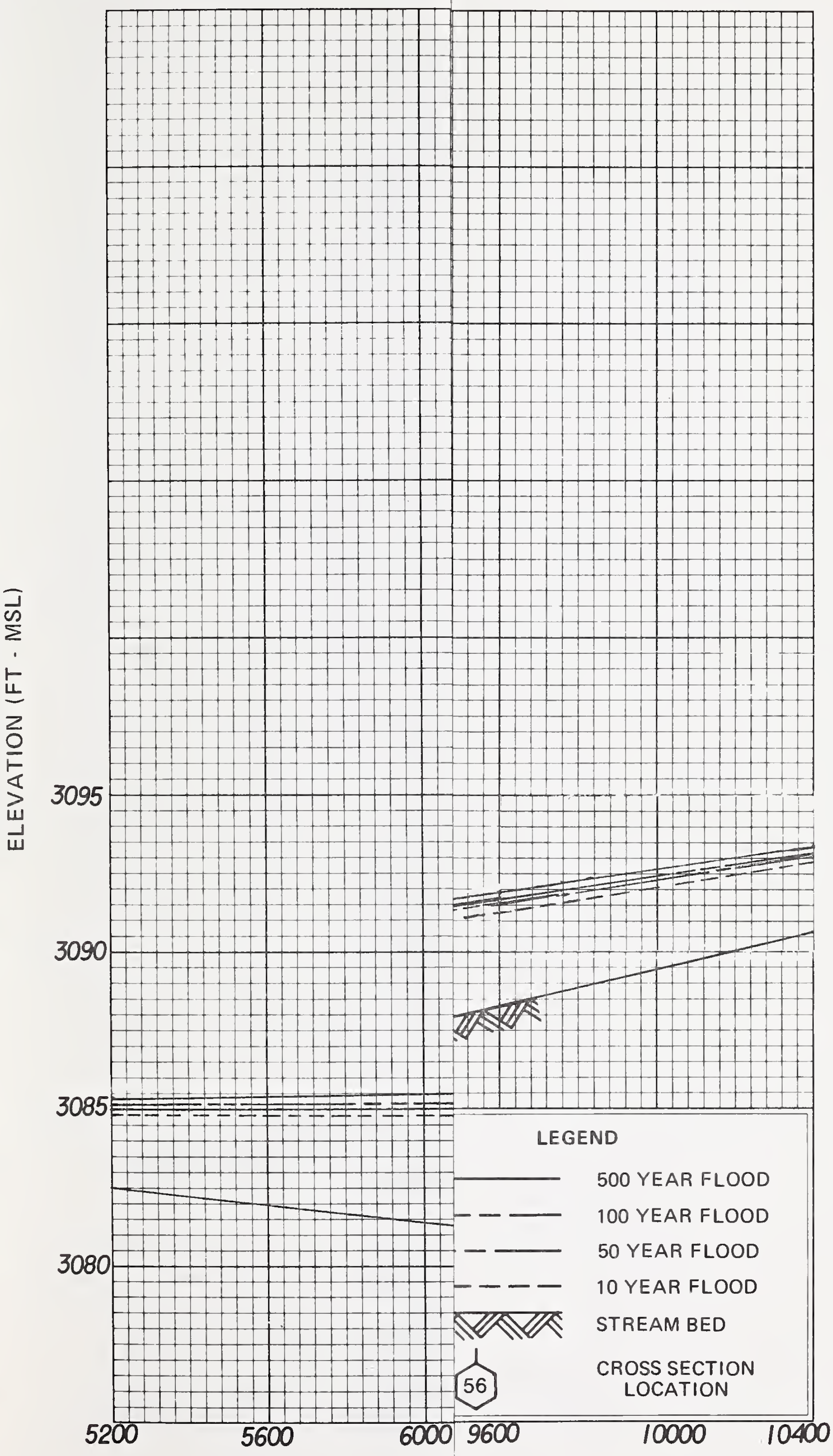
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

WATER SURFACE PROFILES

SPEARMAN DRAW

SHEET 1 OF 6



SPEARMAN DRAW

WATER SURFACE PROFILES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

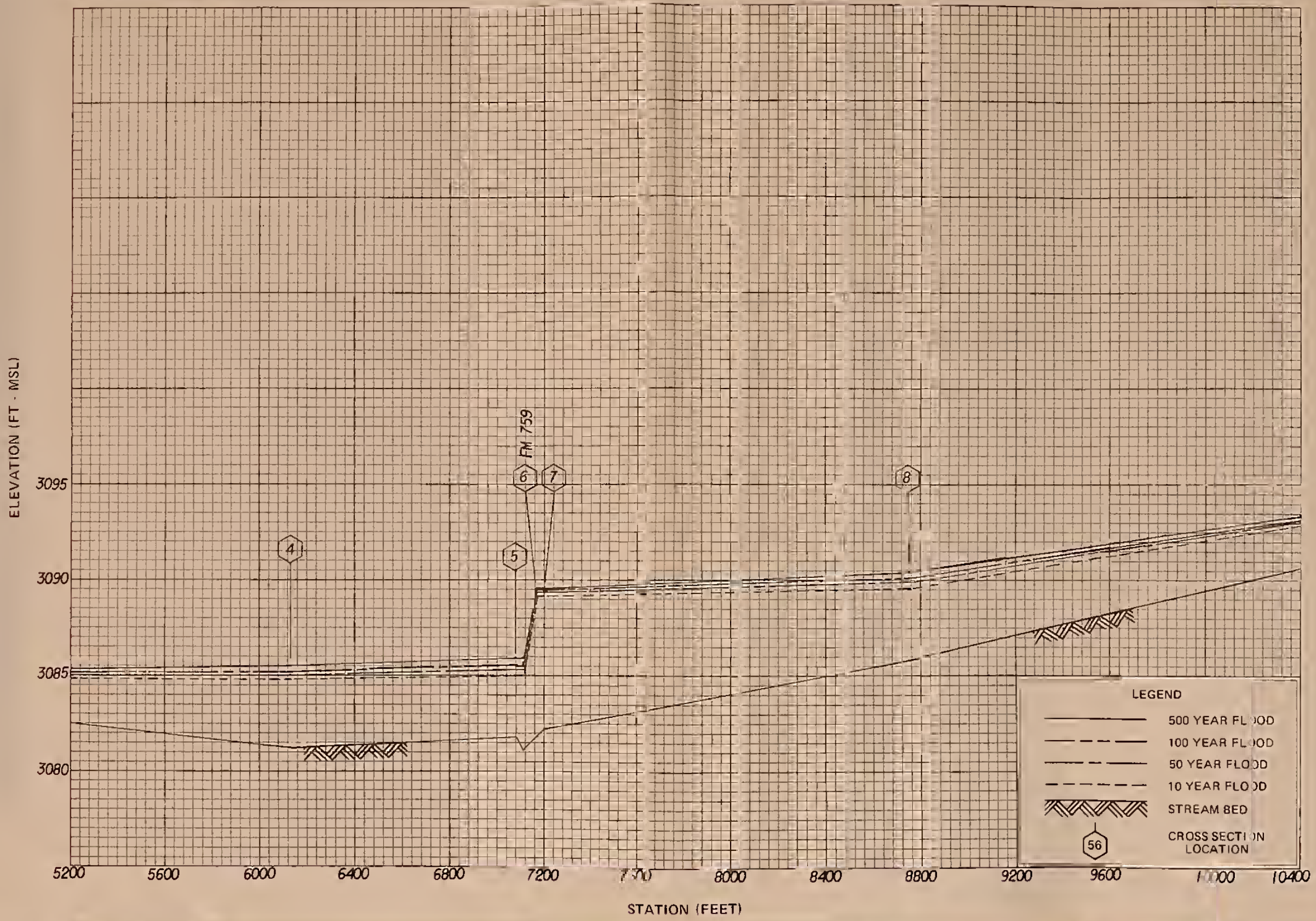
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

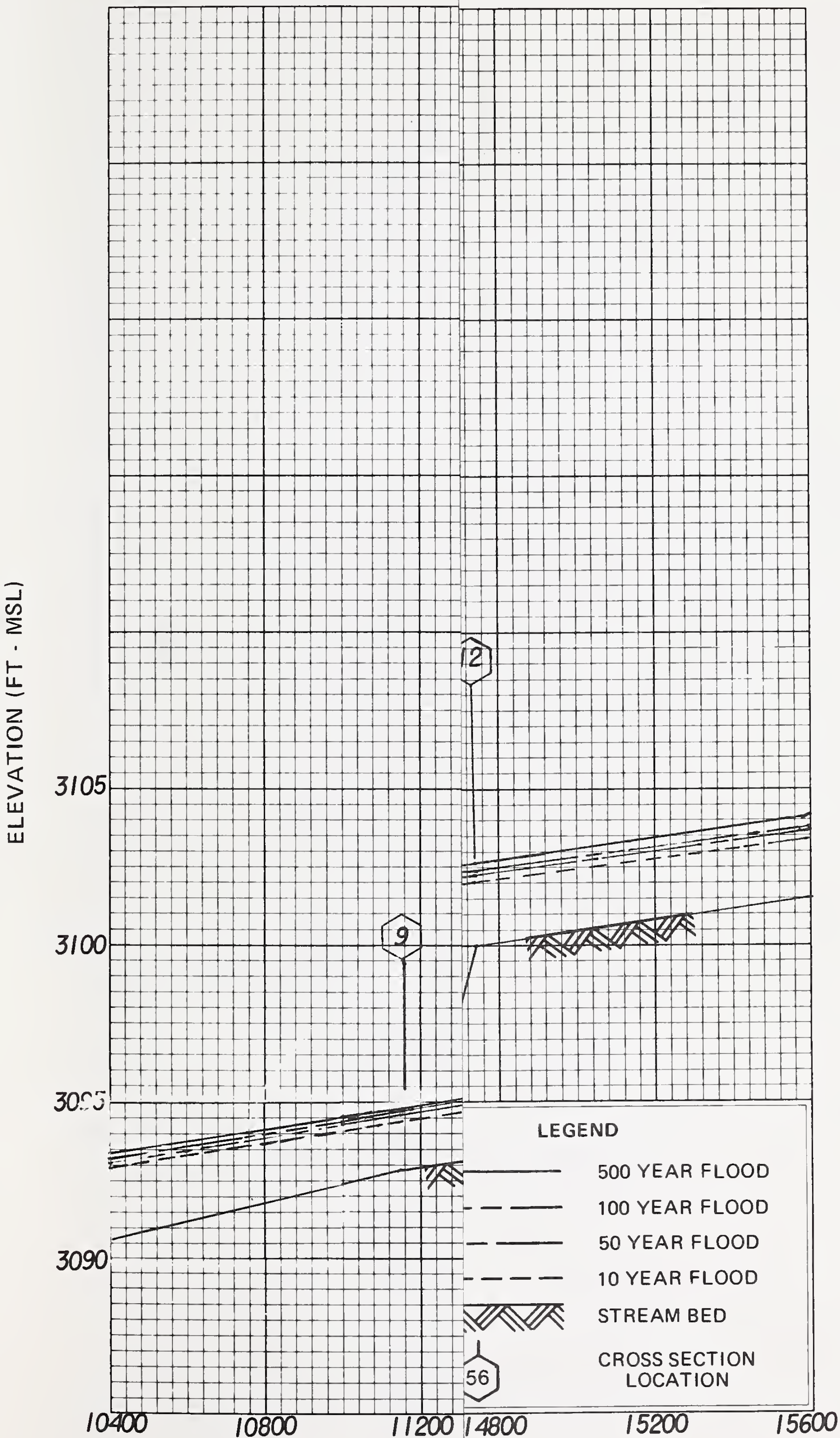
SHEET 2 OF 6

SPEARMAN DRAW

WATER SURFACE PROFILES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS





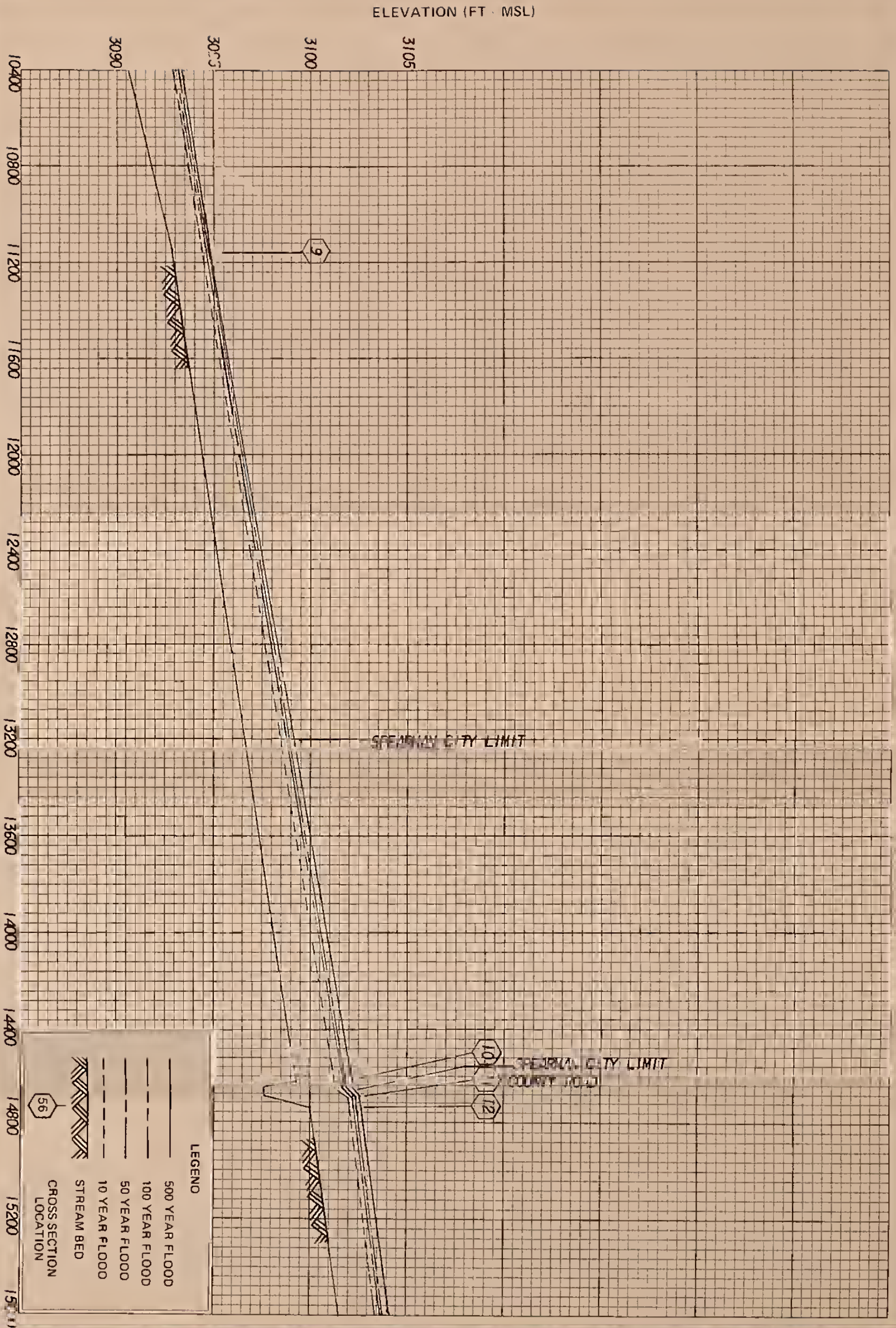
SPEARMAN DRAW

WATER SURFACE PROFILES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 3 OF 6



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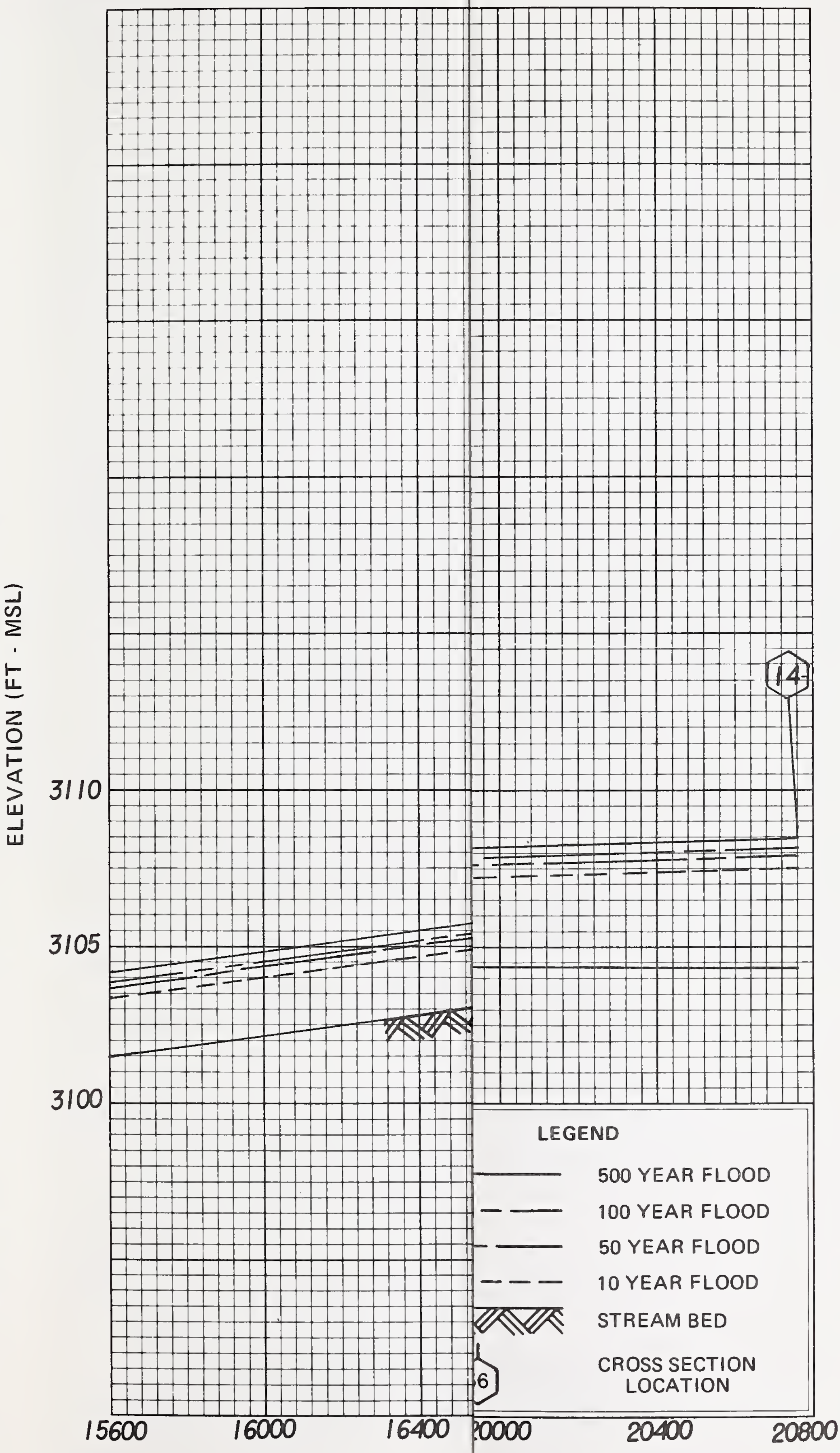
SOIL CONSERVATION SERVICE

CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 3 OF 6

WATER SURFACE PROFILES

SPEARMAN DRAW



WATER SURFACE PROFILES

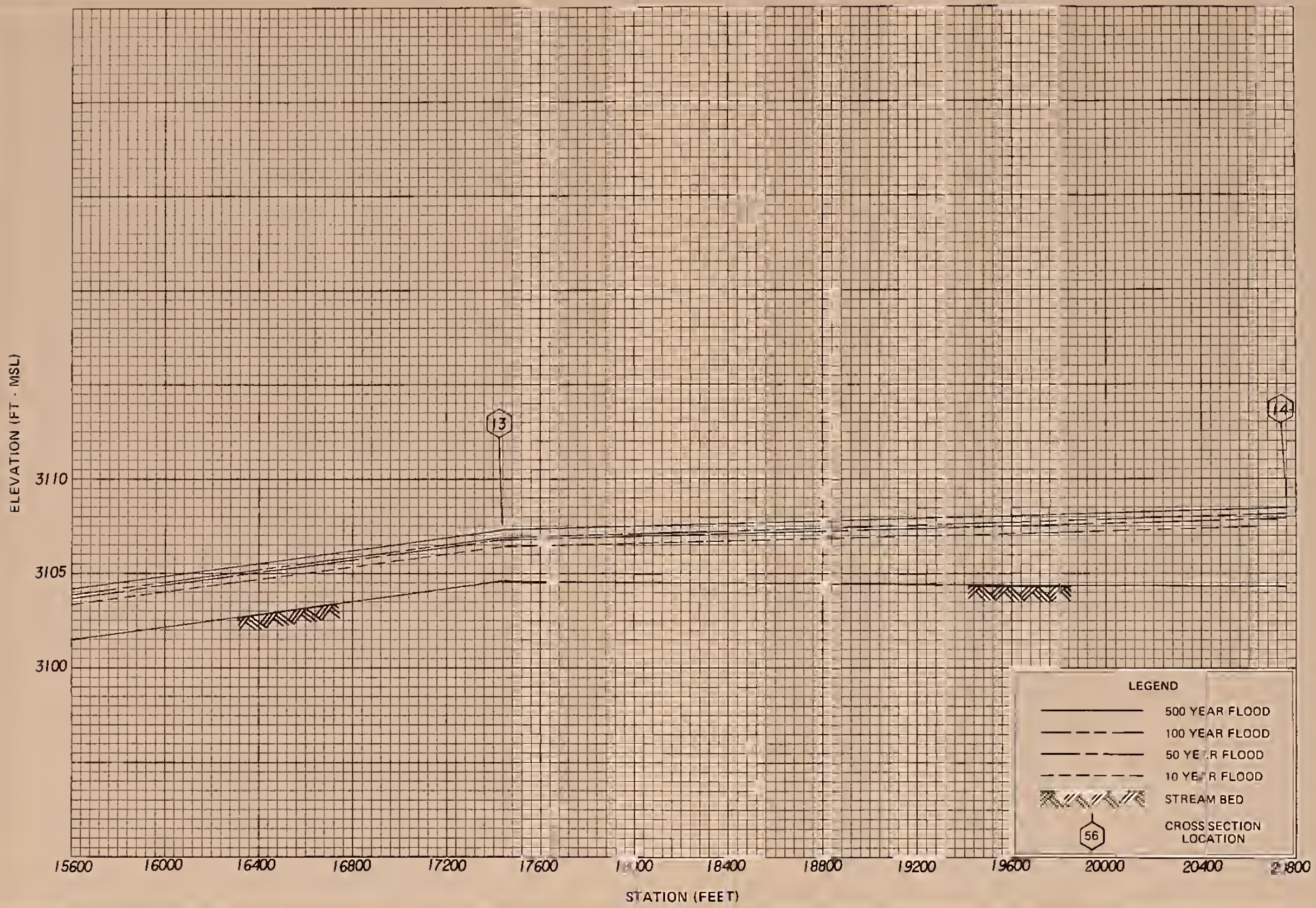
SPEARMAN DRAW

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 4 OF 6

SPEARMAN DRAW

WATER SURFACE PROFILES



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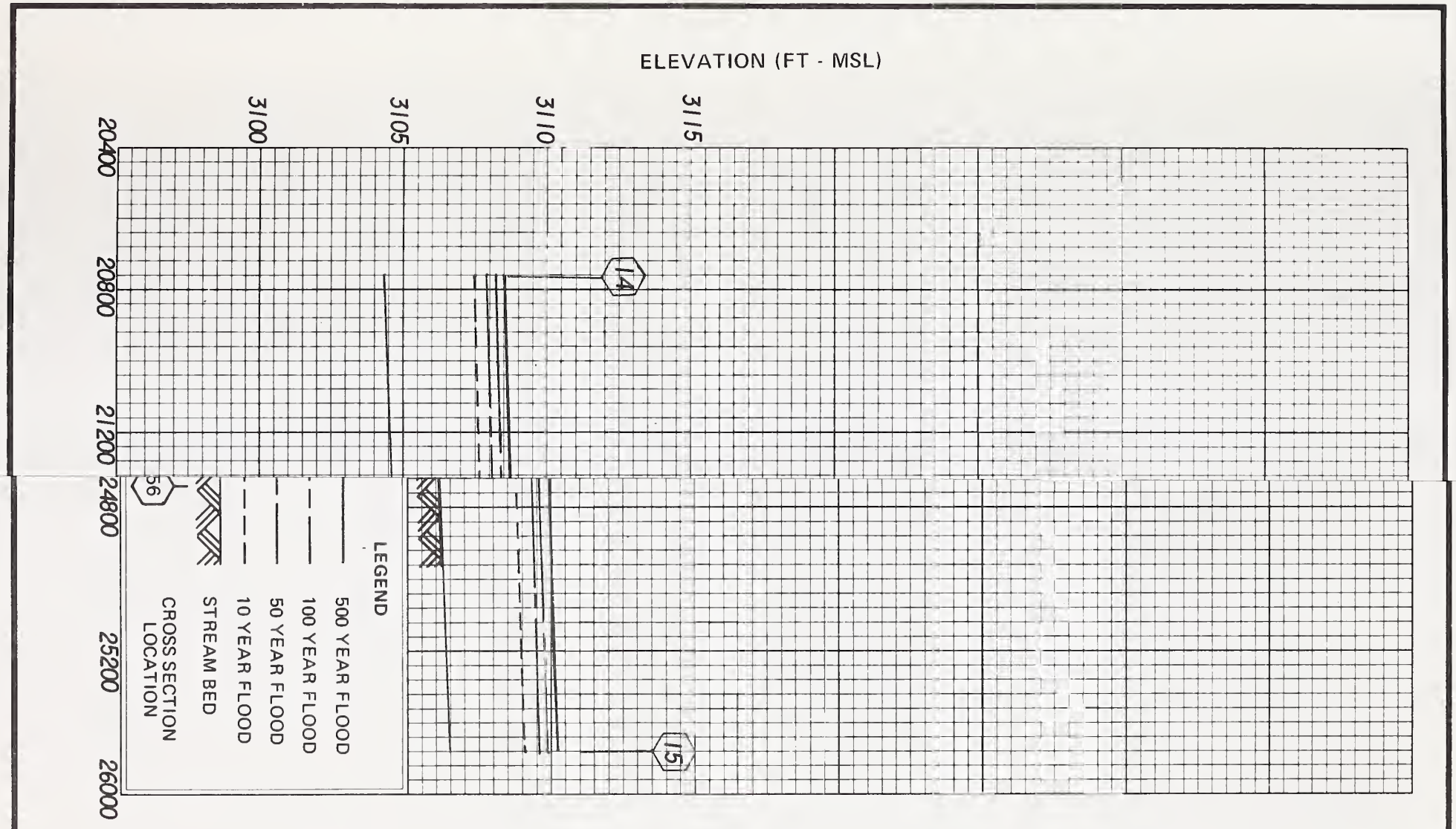
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 4 OF 6



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SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

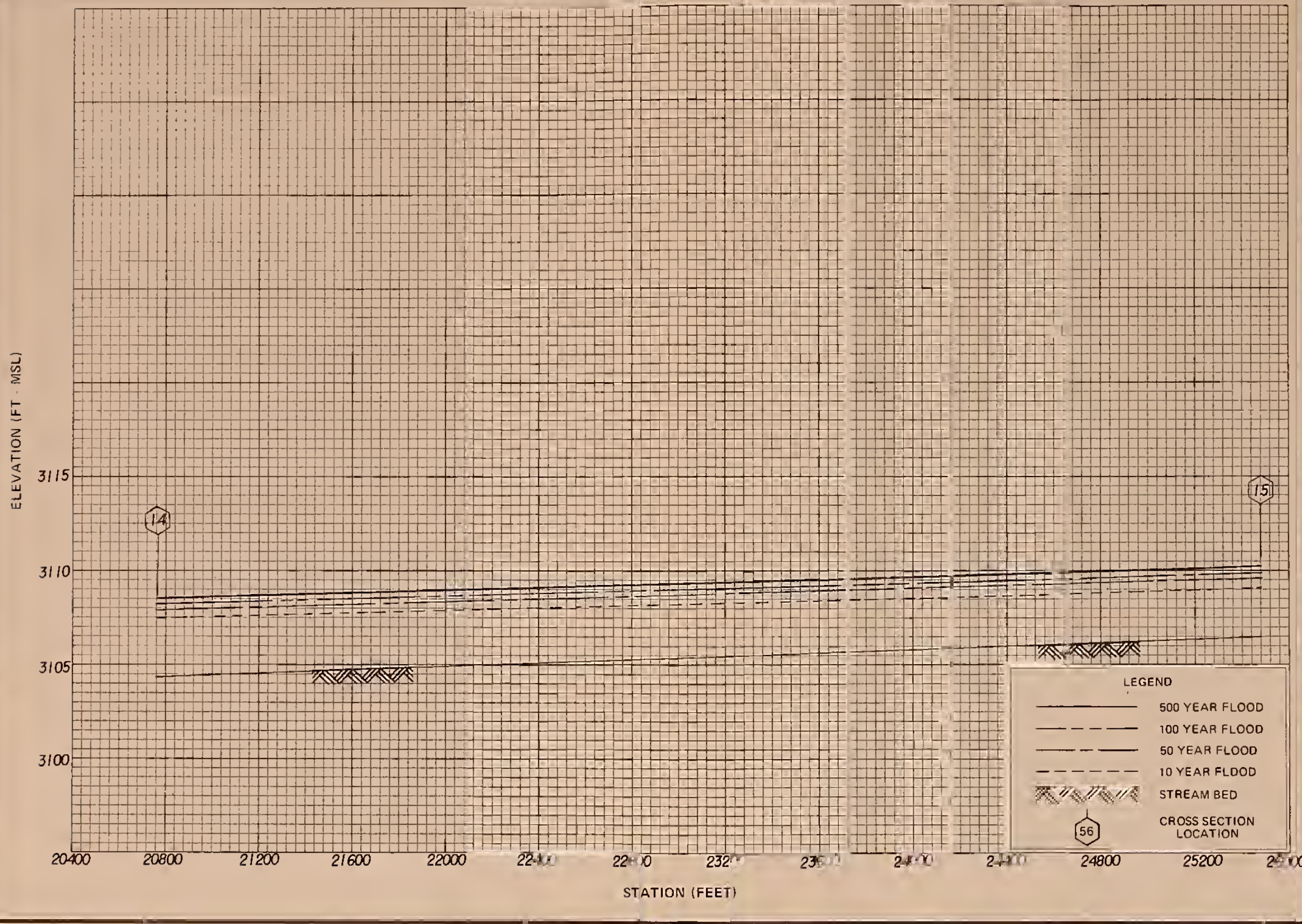
SHEET 5 OF 6

WATER SURFACE PROFILES

SPEARMAN DRAW

SPEARMAN DRAW

WATER SURFACE PROFILES



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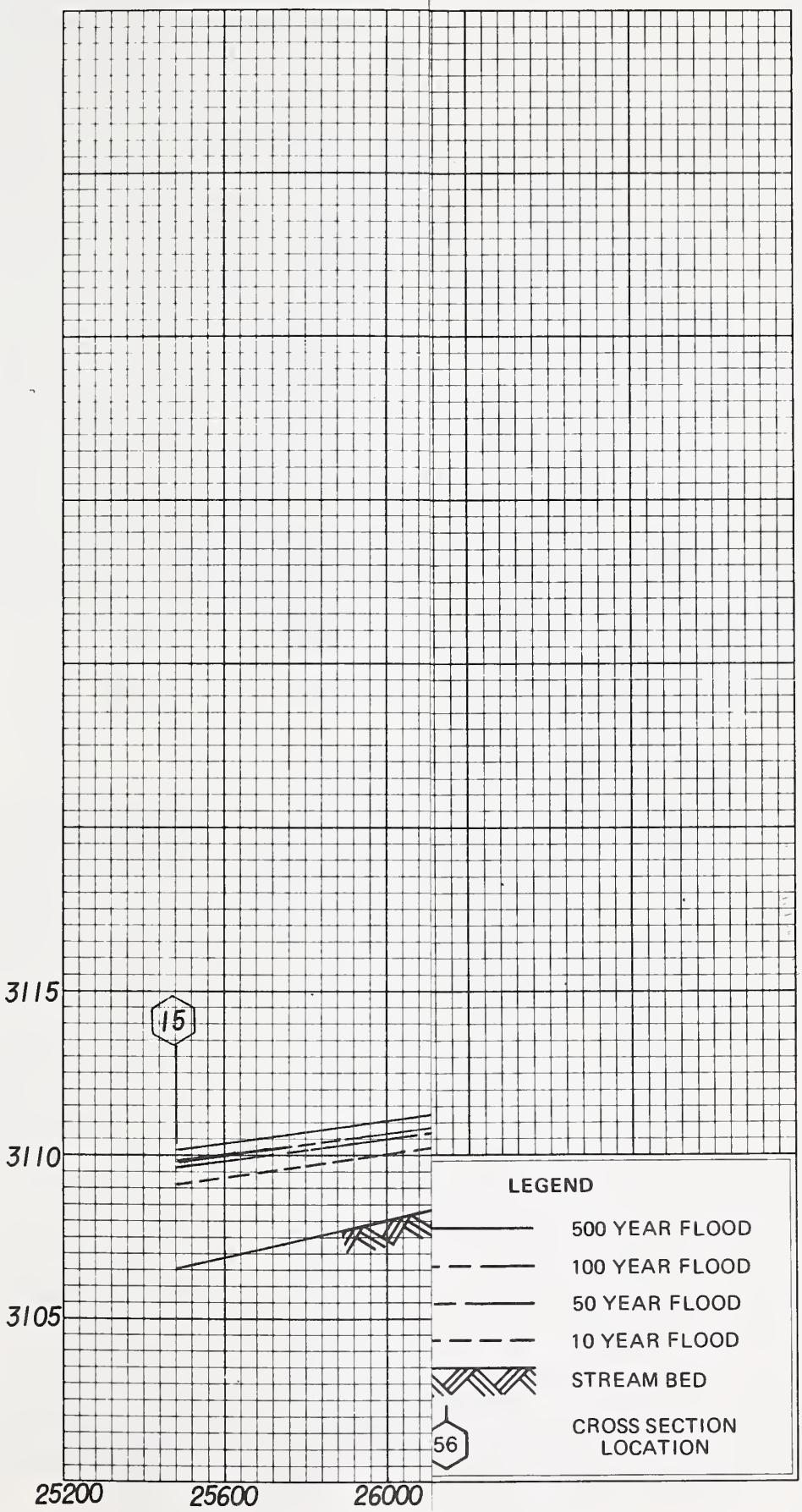
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 5 OF 6



SPEARMAN DRAW

WATER SURFACE PROFILES

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HANSFORD COUNTY, TEXAS

SHEET 6 OF 6

SPEARMAN DRAW

WATER SURFACE PROFILES

U.S. DEPARTMENT OF AGRICULTURE
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FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

SHEET 6 OF 6

ELEVATION (FT - MSL)

3115
3110
3105

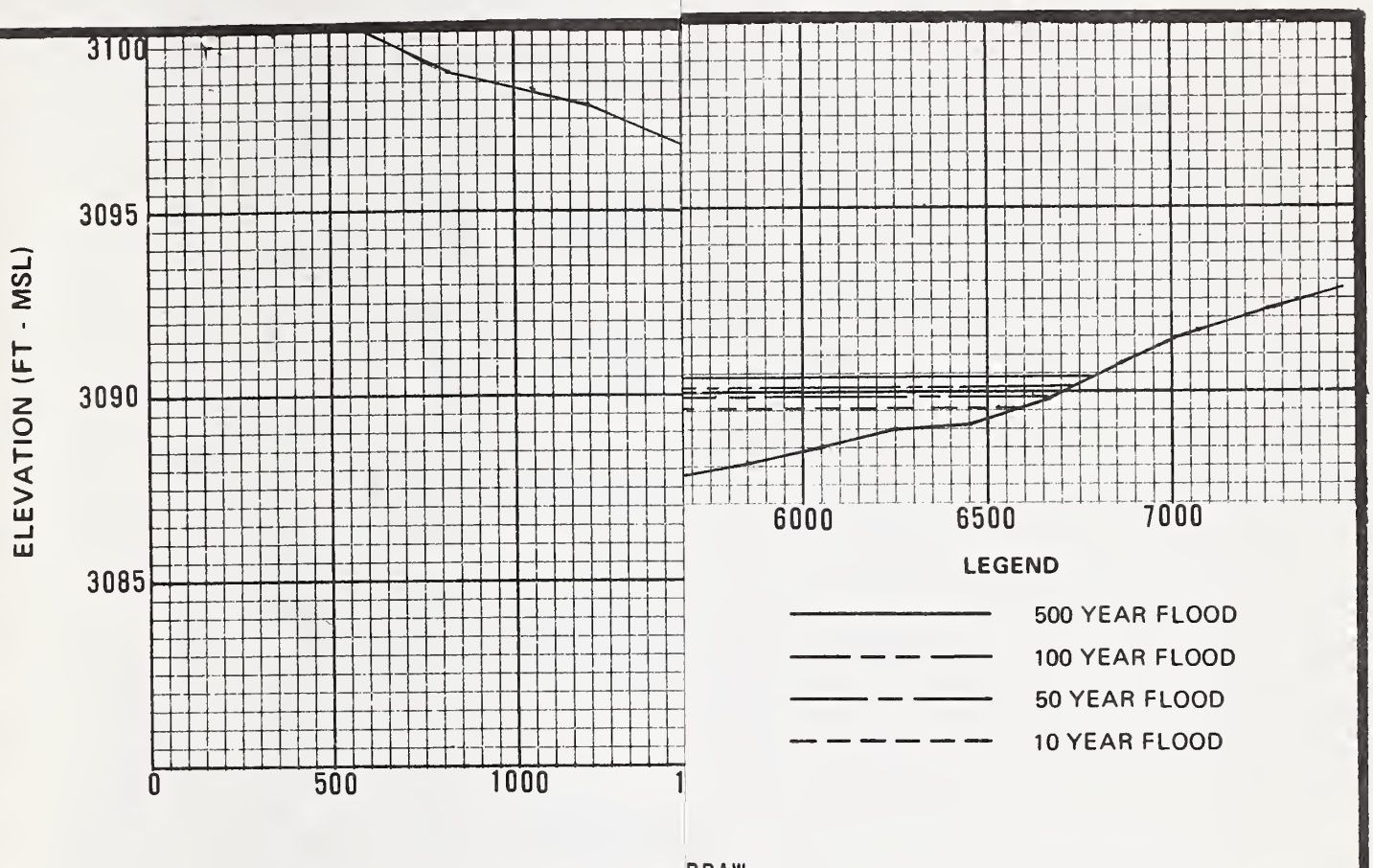
25200 25600 26000 26400 26800 27200

STATION (FEET)

15
16
STUDY LIMIT

LEGEND

500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
S6 CROSS SECTION LOCATION



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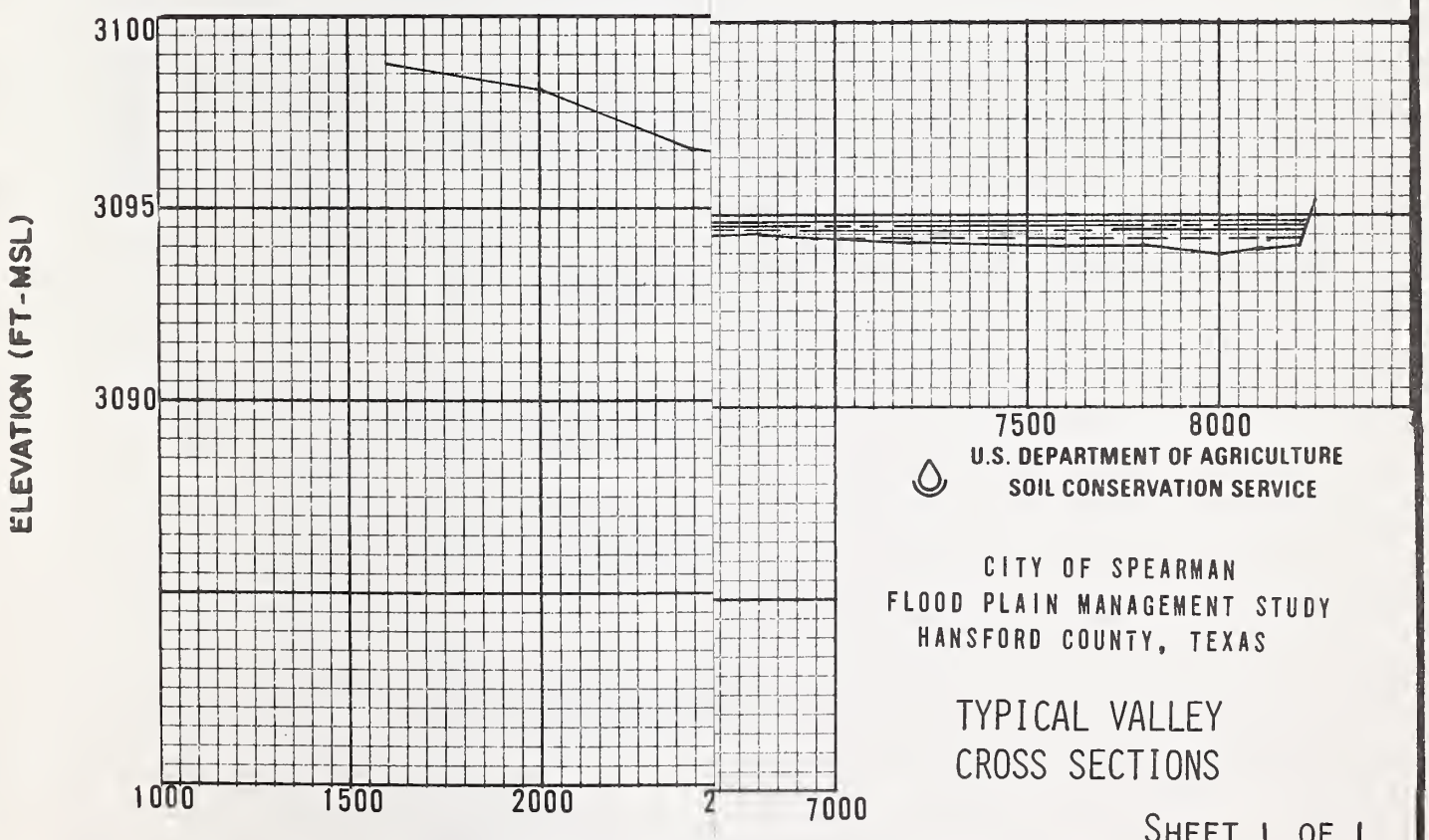

DRAW

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS

TYPICAL VALLEY CROSS SECTIONS

SHEET 1 OF 1

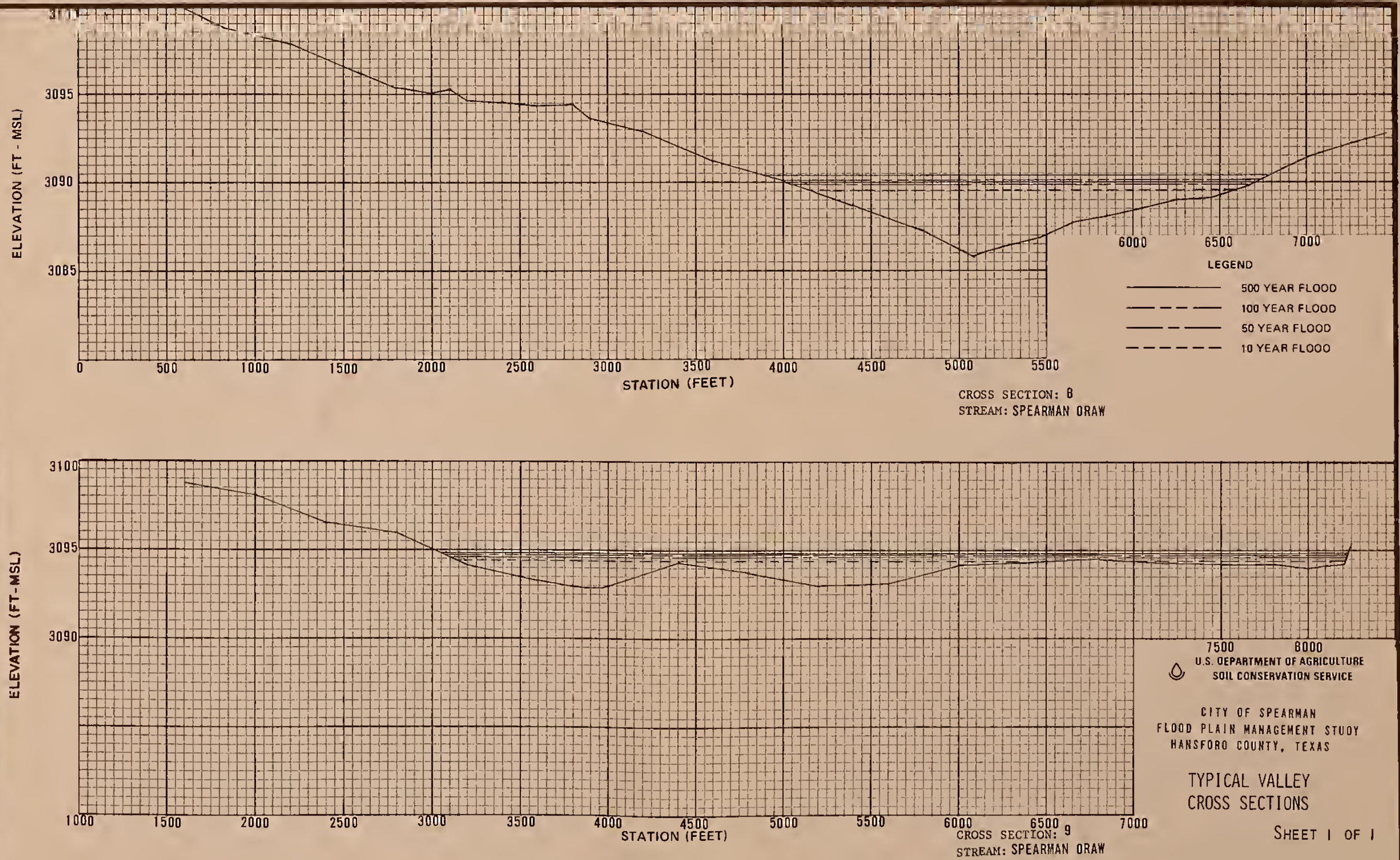
ELEVATION (FT - MSL)
3095
3090
3085
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
STATION (FEET)
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
CROSS SECTION: 8
STREAM: SPEARMAN DRAW
ELEVATION (FT-MSL)
3100
3095
3090
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
STATION (FEET)
CROSS SECTION: 9
STREAM: SPEARMAN DRAW
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CITY OF SPEARMAN
FLOOD PLAIN MANAGEMENT STUDY
HANSFORD COUNTY, TEXAS
TYPICAL VALLEY
CROSS SECTIONS
SHEET 1 OF 1

TABLE 2
CITY OF SPEARMAN
ELEVATION AND DISCHARGE TABULATIONS

PRESENT CONDITIONS

Cross Section Number	10-YEAR FREQUENCY			50-YEAR FREQUENCY			100-YEAR FREQUENCY			500-YEAR FREQUENCY		
	Discharge cfs	Elevation M.S.L. Feet	Flood Plain Width Feet	Discharge cfs	Elevation M.S.L. Feet	Flood Plain Width Feet	Discharge cfs	Elevation M.S.L. Feet	Flood Plain Width Feet	Discharge cfs	Elevation M.S.L. Feet	Flood Plain Width Feet
1	1840	3077.4	1580	2953	3077.8	1687	3480	3077.9	1725	4769	3078.2	1832
2	1842	3081.9	1600	2955	3082.5	2048	3481	3082.7	4275	4771	3083.0	4806
3	1845	3084.7	6120	2960	3084.9	6314	3550	3085.0	6411	5075	3085.3	6703
4	1856	3084.8	2501	2965	3085.0	2524	3492	3085.2	2548	4788	3085.5	2583
5	1864	3085.0	1487	2970	3085.3	1525	3497	3085.5	1550	4792	3085.9	1602
6	1864	3089.2	2200	2970	3089.4	2455	3497	3089.5	2515	4792	3089.6	2576
7	1864	3089.2	3350	2970	3089.4	3717	3497	3089.5	3900	4792	3089.6	4033
8	1878	3089.6	2447	2979	3089.9	2623	3505	3090.1	2720	4801	3090.4	2880
9	1895	3094.4	5069	2987	3094.6	5121	3512	3094.7	5147	4808	3094.8	5173
10	1921	3101.3	1515	3009	3101.7	1658	3525	3101.8	1681	4815	3102.2	1772
11	1921	3101.9	1477	3009	3102.2	1582	3525	3102.3	1618	4815	3102.6	1723
12	1921	3102.0	1751	3009	3102.3	1843	3525	3102.4	1875	4815	3102.7	1967
13	1924	3106.4	1596	3012	3106.8	1952	3528	3106.9	2085	4818	3107.3	2486
14	2170	3107.5	4600	3502	3107.9	4840	4207	3108.2	4975	5929	3108.5	5051
15	2260	3109.1	4035	3587	3109.6	4431	4350	3109.8	4567	6170	3110.2	5085
16	2272	3111.7	2895	3603	3112.0	3080	4366	3112.1	3160	6190	3112.6	3561

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SPEARMAN

HANSFORD COUNTY, TEXAS

Flood Hazard Area Sheet Number	Elevation Reference Mark Name	Elevation (Ft. MSL)	Description
2	13	3085.64	From intersection of Highway 760 and Highway 759, east along Highway 759 2.0 miles, thence north 1.0 mile along gravel road to field road, thence west 1.0 mile to field road intersection, in northeast quadrant of field road intersection, a chiseled "X" on northeast flange bolt of irrigation pump housing.
3	7	3092.34	Five tenth (0.5) mile north of intersection of Highway 760 and Highway 759, on north end of 15-inch steel culvert pipe at private driveway to the west, approximately 50' southeast of east end cross section No. 3, a chiseled square.
4	11	3088.85	Two (2) miles east of intersection of Highway 760 and Highway 759 to a N-S gravel road,in the southwest quadrant of the intersection and on the west end of a 30 inch concrete culvert, a chiseled square.
6	USC&GS Spearman	3104.610	At City water tank, west quadrant of Sanders Street and Davis Street in the concrete foundation at N.E. leg of tower, a standard bronze disk stamped "Spearman 1934".
6	6	3092.32	In the southeast quadrant of the intersection of Highway 760 and Highway 759, in the center of the headwall of a triple box culvert, a chiseled square.

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

CITY OF SPEARMAN

HANSFORD COUNTY, TEXAS

Flood Hazard Area Sheet Number	Elevation Reference Mark Name	Elevation (Ft. MSL)	Description
8	2	3110.29	In the southeast quadrant of the intersection of South Roland Street and west 11th Avenue, a chiseled " + " on the west flange bolt of fire hydrant.
9, 10	5	3102.92	From Highway 759 south along Highway 760, 1.0 mile to intersection of Highway 760 and 13th Avenue, in southeast quadrant of intersection in center of headwall of five pipe culvert, a chiseled square.
11	8	3101.07	From intersection of Highway 760 and Highway 759, thence east on Highway 759 about 1.0 mile; thence south 2.0 miles, 1.7 feet north of south end of 24 inch CMP on west side of road at section line field entrance trail, a chiseled "X".
11, 12	4	3111.24	From Highway 759 south along Highway 760 2.0 miles, top concrete right-of-way post, east right-of-way of highway, a chiseled square.
12	3	3112.89	Approximately 2.2 miles south of junction of Highway 207 and south Roland Street, in center of east headwall of twin box culvert under South Roland street, a chiseled square.